3-8-2013

W141 Commercial Vegetable Disease Control Guide-2013

Steve Bost

UT Extension
W 141

Commercial Vegetable Disease Control Guide – 2013

THE UNIVERSITY of TENNESSEE
INSTITUTE of AGRICULTURE

Commercial Vegetable Disease Control Guide

2013

Prepared by Steve Bost, professor (Extension plant pathologist), in cooperation with research and Extension personnel of the Entomology and Plant Pathology Department and Plant Sciences Department of the University of Tennessee.
The Southeastern Vegetable Extension Workers group is also gratefully acknowledged.

http://utextension.tennessee.edu/publications/Documents/W141.pdf

Cover Photos:

Upper left: Late blight on tomato fruit and stem.
Upper right: Downy mildew on pumpkin.
Lower left: Wilting of squash caused by *Phytophthora capsici*.
Lower right: Plectosporium blight on pumpkin.

Contents

Pesticide Safety

- Follow the directions, and heed all precautions on the labels.
- Know any hazards that the pesticide might present – to you or anyone else.
- Avoid prolonged inhalation of pesticide sprays or dusts; wear personal protective equipment and clothing if specified on the container.
- If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on the skin or clothing, remove the clothing immediately and wash skin thoroughly.
- Comply with the Worker Protection Standard (WPS). The WPS requires the agricultural employer to be responsible for reducing the pesticide exposure of employees. The WPS mandates pesticide safety education, specific restricted entry intervals (REI's), personal protective equipment and worker access to information. A product's WPS specific requirements are found in the Agricultural Use section of the label. All require employers to notify workers of a pesticide application with a display at a central location.

- Comply with the Right-To-Know law. Have the product labels readily available for workers to see. Have the Material Safety Data Sheet (MSDS) for each product available for workers to see and for rescue or fire personnel to use in case of emergency.
- Store pesticides in original containers under lock and key – out of the reach of children and animals – and away from food and feed.
- Apply pesticides so they do not endanger humans, livestock, crops, beneficial insects, fish and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants or in ways that may contaminate water or leave illegal residues.
- Do not clean spray equipment or dump excess spray material near ponds, streams or wells. Do not use the same equipment for insecticides or fungicides that you use for herbicides.
- Restricted-use products may only be purchased and applied by certified applicators or persons under their direct supervision. There are categories of applicators, and a test must be passed to become a certified applicator in the appropriate category. Once the test is passed, the applicator must be recertified periodically through continuing education.
- The USDA requires that records are kept for the use of all restricted-use products. Forms are available at your county Extension office. Record keeping is advisable for nonrestricted pesticides as well.
- Dispose of empty pesticide containers promptly and according to the law.

Use Pesticides Safely
Follow Label Directions
U.S. Department of Agriculture

Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

Disclaimer Statement

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others that may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product. The author(s), the University of Tennessee Institute of Agriculture and University of Tennessee Extension assume no liability resulting from the use of these recommendations.

Foreword: What Is a Plant Disease?

The term ***plant disease***, as used in this publication, refers to a plant problem caused by a pathogen, such as a fungus, bacterium, virus or nematode. Other types of plant problems include ***disorders***, caused by cultural or environmental factors, and ***pest damage***, caused by insects or other animals that feed on or otherwise damage plants. This publication only deals with pathogen control and does not address disorders and pest damage.

I. Cultural Practices for Disease Control

Chemical control practices comprise a large part of this publication, because they change so frequently, but make up only a small part of the overall disease control program. Cultural practices are the backbone of disease control.

Crop Rotation
Rotating fields to unrelated crops each year will decrease the populations of many types of disease-causing organisms in the soil. Because pathogens tend to attack several members of one plant family but not another, crop rotations should involve different families. Grass crops or corn almost always make a good rotation crop. At least two years should be allowed between plantings of the same family, but the longer the rotation, the less likely that an early-season outbreak of a disease will occur. The vast majority of plant diseases are lessened even by one year out of a crop.

Crop rotation is effective in reducing pathogens that spend at least part of their life cycle in the soil, which applies to most of them. Examples of pathogens that do not survive in the soil and, thus, are not controlled by crop rotation, include the rusts, the downy mildews, the powdery mildews and viruses other than tobacco mosaic. Crop rotation is very effective against pathogens that survive short periods in the soil on plant debris, such as those that cause foliar and fruit diseases. Crop rotation will reduce, but not eliminate, soil inhabitants that are long-lived, such as Phytophthora and Fusarium.

Proper environment
Provide the crop with favorable drying conditions and soil drainage so that the plants are not exposed to prolonged wet conditions, which favor both root and foliar diseases. Select sites that are not lined by trees and have good internal soil drainage. Using raised beds, reducing plant densities and foregoing sprinkler irrigation are considerations for minimizing diseases. Weeds can increase diseases by interfering with drying conditions and by providing an alternate host for certain pathogens.

Resistant Varieties
The use of resistant varieties is one of the most economical ways of controlling vegetable diseases. Resistance to a disease should be employed if a farm or the vicinity has a history of the disease. Especially when used in combination with crop rotation, varieties with resistance to soilborne diseases will result in the longterm decline of the pathogen population. The use of resistance to foliar disease will decrease the reliance on chemical control. Resistant varieties are not available to all diseases or may only be effective against certain strains. Resistant varieties may become ineffective as pathogens develop the ability to overcome the resistance.

Good Crop Husbandry
Plants that have good, but not excessive, vigor are the most resistant to disease. Plants weakened by improper soil pH, inadequate fertilization, crowding, weed competition or planting when the soil is too cool are more subject to pathogen invasion and disease development. Lush growth caused by excessive fertilization can decrease drying conditions. Follow closely all production recommendations for each crop.

Prevent Disease Introduction
Often the most effective and successful control of a disease is to prevent it from occurring in the first place. Many diseases are difficult to deal with after they appear, as they lack adequate controls.

Disease-free seed and transplants are a must. Do not save seed, as they have a greater risk of harboring pathogens. External appearance of seed or transplants cannot be relied upon as an indicator of the presence of the pathogen, as there are usually no symptoms. Buy certified transplants, understanding that certification is no guarantee of freedom from disease. Buy seed that is certified and, if possible, has been tested for bacterial pathogens. Hot water and chlorine bleach treatments of seed decrease the chance of pathogen infestation, but do

not substitute for the certification process. The western U.S. is a preferred source of seed because the arid climate decreases the chance of disease transmission. However, western-grown seed is not always available.

Some disease-causing organisms can be introduced to a field on contaminated equipment or containers. Cultivate noninfested vegetable fields before moving to fields infested with particularly troublesome pathogens. Equipment or containers that have been used in infested fields should be washed with a strong stream of water and disinfested with a bleach solution before being used in other fields.

Avoid using tobacco while working in tobacco mosaic-susceptible crops, such as tomato and pepper. Tobacco mosaic virus is carried in tobacco products and is easily transmitted on workers' hands. Workers should wash their hands thoroughly in soap and water after handling tobacco and before they work with tobacco mosaic-susceptible plants.

Remove the Pathogen
Destroy the overwintering habitat of the pathogen, such as crop debris left in the field. The most practical way to do this is to disk it into the soil. Most pathogens are unable to survive once the crop residue decomposes, and disking it in enhances the decomposition process. Eliminate cull piles by burying before the next crop is planted.

Removing diseased plant parts from the field is not a common practice in vegetable production but may have a role in certain systems, such as asparagus production. As a perennial crop, disking crop debris at the end of the growing season is not an option. However, removing the debris and burning it reduces overwintering inoculum of foliar diseases.

Roguing, or removing entire plants from the field, may be used in certain situations for reducing inoculum. It generally is only effective when done immediately upon the first detection of a disease, with the goal of arresting an epidemic in its initial stage. Furthermore, roguing can actually result in increased disease by scattering the pathogen during the removal process (e.g., southern blight) or by causing insect vectors to scatter (e.g., tomato spotted wilt virus).

II. Chemical and Biological Control

Biological and chemical controls are available for management of diseases caused by fungi, bacteria and nematodes. Although there are no viricides, virus diseases that are vectored by insects may be managed with certain insecticides.

Plant diseases cannot be controlled satisfactorily just by spraying. Disease control should be approached as a program that integrates all of the cultural practices mentioned above. Applications of sprays, dusts, fumigants, etc. for plant disease control should only be considered supplements to the cultural practices.

The use of certain strains of bacteria and fungi to control plant pathogens is called **biological control** or **biocontrol**. Some of these organisms are commercially available and can be quite effective in certain situations. Biocontrols offer the advantage of lessened environmental impact and increased worker safety. Often, biocontrols work more slowly and tend not to be as effective as synthetics when disease pressure is high. Certain biocontrol products are listed in the recommendations if adequate research has been conducted to elucidate their role.

Chemical control of plant diseases includes synthetic and naturally occurring compounds. Most chemicals affect the pathogen directly while some, such as Actigard, induce plant resistance to certain pathogens.

Disease-control products include seed treatments, soil sprays, soil fumigation, nematicides, foliar sprays and post-harvest treatments. Products available for use are addressed in the sections that follow. Only brief instructions for use are provided; **always refer to the label for full instructions, restrictions and other information.**

A. Seed Treatment

Seed treatment accomplishes plant disease control by reducing seedling disease as well as mature-plant diseases caused by seed-borne pathogens. Most seedling diseases are caused by pathogens found in the soil, whereas those pathogens found on or in the seeds tend to cause mature-plant diseases. Seed disinfestation and seed protection are types of seed treatments used to reduce diseases.

1. Seed Disinfestation

Seeds can be disinfested, i.e., cleaned of most pathogens carried on the seeds, by treatment with hot water, chlorine bleach or trisodium phosphate. Hot water also kills some of the bacteria carried inside the seed. None of these treatments provides residual protection against organisms encountered in the soil after planting. Treatment of seeds with fungicides is required for such protection.

Most seed companies offer seed treatment options, and it is recommended that you utilize such services, rather than attempt to treat the seeds yourself. Unless the procedures are adhered to closely, much damage can be done during the seed treatment process. For example, an entire lot of seeds can be contaminated with bacterial pathogens that spread in water that is not hot enough; seed germination can be reduced by water that is just slightly too hot. Furthermore, many fungicide seed treatments can only be applied by a commercial seed treater and are not available for purchase by the grower. Pelletized seed must be treated prior to the coating process.

Hot water treatment: Pre-warm seed in a cheesecloth bag for 10 minutes in 100 degree F water. Place pre-warmed seed in a water bath that will constantly hold the water at the recommended temperature (see Table 1). Length of treatment and temperature of water must be exact. Agitation of the water during the treatment cycle will help maintain a uniform temperature in the water bath. After treatment, dip the bag in cool water to stop the heating action. Spread seed out on paper towel to dry. A seed treatment fungicide can then be applied to protect against pathogens in the soil.

Caution: Hot water treatment can reduce germination to some degree. The viability of older seed (more than 1 year old) may be drastically reduced. A small sample of seed should be treated and tested for germination before the entire lot is treated. Vegetable seeds other than those listed in Table 1 should **not** be hot-water treated. These seeds may be severely harmed by hot water treatment and other methods should be used. Included are beans, sweet corn, onions and, especially, cucurbits other than cucumber.

Table 1. Water bath temperatures and soaking times for selected vegetable seeds.

Crop	Temp. (°F)	Minutes
Brussels sprouts, cabbage, eggplant, spinach and tomato	122	25
Broccoli, cauliflower, cucumber, carrot, collard, kale, kohlrabi, rutabaga and turnip	122	20
Mustard, cress and radish	122	15
Pepper	125	30
Lettuce and celery	118	30

Bleach treatment: Pathogens can be removed from the surface of seeds with bleach treatments. This method is particularly useful for control of bacterial diseases such as bacterial spot of tomato or pepper. Mix 1 quart of bleach (sodium hypochlorite) with 4 quarts of water and a few drops of dish detergent to decrease surface tension. Soak seed for 1 minute, remove and rinse seed thoroughly in running tap water for 5 minutes; spread seeds on paper towels to dry. North Carolina State University reports that tomato seeds can be soaked in this bleach solution for 40 minutes without serious harm to the seeds. Treat a small sample size and test for seed germination before the entire lot is treated. After drying, a seed treatment fungicide may be applied.

Tobacco mosaic virus on pepper and tomato seeds can be reduced with a **trisodium phosphate treatment**. Soak seeds for 15 minutes in a 10 percent solution, rinse and dry before treating with household bleach.

2. Seed Protection

The purpose of seed protection is to reduce the plant stand loss effect of seed rots and damping-off, caused by soilborne fungi. Most vegetable seed is pretreated by the seed company, using treatments aimed at the common fungi. Captan and thiram are the most common treatments used. If you have unusual seedling disease problems, refer to Table 2 for appropriate treatments and request them when you place your seed order with the company. Certain products can be applied on the farm; follow label directions in treating your own seeds.

Table 2. Common seed treatments for disease control.

Product	Active Ingredient	Pathogen Controlled	Crop
Allegiance-FL Allegiance Dry	metalaxyl	Pythium, suppression of Phytophthora	Most vegetables
Apron Maxx	mefenoxam and fludioxonil	Pythium, Rhizoctonia, Fusarium, suppression of Phytophthora	Legume vegetables
Apron XL LS	mefenoxam	Pythium, suppression of Phytophthora	Most vegetables
Captan 400-C, others	captan	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	Most vegetables
Coronet	pyraclostrobin, boscalid	Rhizoctonia, Penicillium, Fusarium	Brassica, bulb, cucurbit and legume vegetables
Dividend Extreme	difenaconazole, mefenoxam	Rhizoctonia, Fusarium, Pythium	Sweet corn
Folicur/Tebuzol/Orius	tebuconazole	Fusarium	Sweet corn
Dynasty	azoxystrobin	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous fungi	Legume vegetables
FarMore D300	azoxystrobin, mefenoxam, and fludioxonil	Rhizoctonia, Pythium, and Fusarium, suppression of Phytophthora	Tomatoes, peppers, lettuce, spinach, carrots, onions, cucumbers, melons, squash, watermelon, broccoli, cabbage and cauliflower
Kodiak	Bacillus subtilis strain GB03	Rhizoctonia, Fusarium, Alternaria, Aspergillus	Legume vegetables
Maxim 4FS	fludioxonil	Fusarium, Rhizoctonia, Helminthosporium, Aspergillus, Penicillium	Most vegetables and herbs
Prevail	carboxin	Rhizoctonia	Beans
Protector-D	thiram	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	Beans
Thiram 50WP 42-S Thiram	thiram	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	All vegetables
Stamina	pyraclostrobin	Rhizoctonia	Brassica, cucurbit, bulb, and legume vegetables, sweet corn
Trilex	trifloxystrobin metalaxyl	Fusarium, Rhizoctonia, Pythium and other fungi	Beans
Vitavax-34	carboxin	Rhizoctonia	Beans
Vitaflo-280	carboxin, thiram	Rhizoctonia, suppression of Pythium, Fusarium and miscellaneous other fungi	Beans, sweet corn

B. Soil Fumigation

This method will reduce, but not eliminate, fungal, bacterial and nematode pathogens in the soil prior to planting. Some fumigants also provide weed and soilborne insect control. Table 3 contains a brief description of application methods for labeled fumigants. Refer to the label for complete instructions and restrictions. Soil should be warm, well-worked and free from undecomposed plant debris and have adequate moisture for seed germination.

Table 3. Soil fumigants for vegetable crops.

Note: All soil fumigant applications must be in compliance with the EPA's risk mitigation requirements (buffer zones, personal protective equipment, fumigant management plans, etc.).

Vegetable Crop	Product	Broadcast Rate/Acre*	Remarks
Most Vegetables	Telone II (for nematodes only)	9 - 12 gal	Chisels should be inserted 12 in. deep and spaced 12 in. apart for broadcast applications. Wait at least 2-3 weeks before planting.
	Chloropicrin SMDC (Metam CLR, Vapam, or Sectagon 42) K-Pam HL Telone C-17 Telone C-35	150 - 500 lb (1 gal=13.85 lb) 40 - 100 gal 30 - 60 gal 10 - 17 gal 13 - 20.5 gal	Multipurpose fumigants. See label for chisel depth and spacing and plant-back restrictions. Wait 2-3 weeks before planting, or longer in cold, wet soil, or if odor persists.
Asparagus, broccoli, cauliflower, eggplant, lettuce, muskmelon, dry onion, pepper, tomato	Terr-O-Gas 50 Bro-Mean C-50	360 - 480 lb 360 - 480 lb	Multipurpose fumigants. Chisels spaced 12 inches apart, 6-8 inches deep. Cover with plastic film. Refer to label for plant-back intervals.
Pepper, tomato, eggplant, cucumber, melons (all), squash (all)	Paladin	40 - 51 gal (355 - 455 lb)	Shank injection. VIF films only. Film applied immediately and kept in place at least 12 days. Plant-back interval 21-42 days, depending on soil temperature.
	Paladin EC	42 - 54 gal (347 - 479 lb)	For application through drip irrigation. See Paladin remarks.

* In-row applications reduce the per-acre rates proportionately to row spacing and row width.

C. Nematicide Applications

Nematode control is needed in fields in which root galling has been found in the past. At the end of each growing season, plants should be dug up in several locations in each field and examined for evidence of root galling. This direct method of detection of the root-knot nematode is the most accurate. If desired, soil samples can be submitted to a laboratory for analysis. This method can detect all types of nematodes, but root inspection will detect root-knot, which is the most important nematode in vegetable production in Tennessee.

Successful nematode control depends on cultural practices. Refer to UT Extension publication SP 291-I, "Managing Nematodes in Commercial Vegetables," for information on these practices as they apply to nematodes.

Products for controlling nematodes, called nematicides, serve as supplements to cultural practices, not as substitutes. Nematicides are of two types: fumigants and non-fumigants. For fumigant products, see "Soil Fumigants," above. Non-fumigant products are provided in Table 4.

Table 4. Non-fumigant nematicides for vegetable crops.

Product Choices	Application Method	Formulated Rate		Schedule and Remarks
		Per Acre	Per 100 sq ft or 100 ft row	
Bean, snap and lima				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 2 in. to 4 in. deep. See label.
Cabbage				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 3 in. deep. See label.
Carrot				
Vydate 2L	Preplant broad cast	2 gal	--	Apply within 1 week before planting, incorporate into soil 4 in. to 6 in. deep.
	In seed furrow	1 - 2 gal	--	
Cucumber				
Mocap - various formulations	Banded only	See label	See label	Incorporate 2 in. to 4 in. deep. See label.
Cucurbits (cucumber, squash, cantaloupe, watermelon, honeydew, pumpkin)				
Vydate 2L	Preplant broadcast	1 - 2 gal	--	Incorporate 2 in. to 4 in. deep.
	Foliar spray	2 - 4 pt	--	First application 2 - 4 weeks after planting; repeat 2 - 3 weeks later. Do not treat within 1 day of harvest.
Eggplant				
Vydate 2L	Postplant band	1 gal	--	Apply 2 - 3 weeks after transplanting; repeat 4 weeks later. Incorporate by water or mechanically.
	Foliar	4 pt	--	Apply 2 to 4 weeks after the 2nd soil treatment.
Pepper, bell				
Vydate 2L	Transplant water	2 pt in 200 gal water	--	
	Drip irrigation	2 - 4 pt in 40 - 200 gal water	--	Use as a supplement to transplant treatment 14 days after transplanting. Repeat at 1- to 2-wk intervals.
Potato				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 2 to 4 in. deep. See label.
Vydate 2L	At planting in-furrow	1 - 2 gal in 20 gal water		
	Foliar	2 - 4 pt		Begin when early season control has diminished.
Sweetpotato				
Mocap - various formulations	Broadcast or banded	See label	See label	Incorporate 2 to 4 in. deep. See label.
Vydate 2L	Preplant broadcast	2 gal in 20 gal water	--	Thoroughly incorporate into soil 4 in. to 6 in. deep within 1 week of planting.
	Transplant water	1 - 2 gal in 200 gal water	--	

Table 4. Non-fumigant nematicides for vegetable crops, continued.

Product Choices	Application Method	Formulated Rate		Schedule and Remarks
		Per Acre	Per 100 sq ft or 100 ft row	
Sweet corn				
Mocap - various formulations	Banded only	See label	See label	Incorporate 2 in. to 4 in. deep. See label.
Counter 15G	Row, 30-in. minimum	Maximum of 8.7 lb	0.8 oz	Place granules directly in the seed furrow behind planter shoe.
Tomato				
Vydate 2L	Foliar	2 - 4 pt	--	Spray when plants are established. Repeat at 1- to 2-week intervals.
	Drip irrigation	2 - 8 pt	--	Apply at first irrigation; repeat every 1 to 2 wks. Use 2 pt to 4 pt while plants are small, increasing gradually to 8 pt.

D. Fungicide and Bactericide Sprays

1. The Purpose of Table 5

In Table 5, chemical and biological control product choices are provided for the major diseases on the major crops in Tennessee. This table is not a spray schedule; it provides product choices for a number of diseases for each crop. It is intended as a reference, so that the grower can develop a spray program suitable for his/her farm situation. Diseases that are important to you may not be a factor elsewhere, and vice versa.

2. Designing a Spray Program

In general, incorporate the chosen products into a spray program that features disease prevention while minimizing the number of applications and abides by product label restrictions. Excessive use of chemicals is expensive and increases the chances of resistance development in the pathogen populations.

- Disease control must be approached preventively, for the most part. Plan your program by selecting broad-spectrum, protectant fungicides such as mancozeb or chlorothalonil that are labeled for the crop.
- Use Table 5 to determine which products are labeled for use and are effective against the diseases that are important on your farm. Use efficacy tables, if available, to compare the fungicides for effectiveness on those diseases. Two such tables can be found in Appendices 3 and 4. Price should also be a consideration in product selection.
- When to begin spraying depends on the crop, the weather, the disease history in the field and when the crop was planted. On crops that are highly subject to foliar diseases, such as tomatoes, the spray program should begin as soon as the first week after planting, especially on late plantings.
- How often to spray depends on the weather, but usually is in the 7- to 14-day range. Five-day intervals, if allowed by the label, may be necessary if certain difficult-to-control diseases are present and rainy weather occurs. Rainy weather favors most diseases, and more frequent sprays are needed under such conditions.
- Scout the crop regularly and add specialized fungicides to the program as appropriate for diseases such as late blight of tomato, downy mildew of cucurbits, powdery mildew of cucurbits and *Phytophthora capsici* blight of several crops.
- Engage in resistance management for those fungicides that are at risk for losing effectiveness (Appendix 2). The at-risk group includes the strobilurins, which are commonly used in vegetable production. Most at-risk fungicides must be alternated with non-related fungicides, although some can be applied two consecutive times before rotating to a non-related fungicide.
- Most products have a labeled limit on the number of times or the amount applied to a crop. Abide by these limits in designing your program. They are found on the label and in Table 5.
- Heed the preharvest interval (PHI). It may be necessary to make an alternate choice of fungicides during the harvest period. For example, the 5-day PHI of mancozeb on tomato interferes with the harvest schedule.

Table 5. Foliar, soil and post-harvest applications of disease-control products.

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
ALL VEGETABLES						
Post-harvest rots		sodium hypochlorite (various brands)	See label			Submerge 2 min., rinse. Change solution when visibly dirty. Never permit chlorine solution to fall below 25 ppm.
		hydrogen dioxide	See label			See label
		peroxyacetic acid + hydrogen peroxide (various brands)	See label			See label
ASPARAGUS						
Rust Brick-red pustules on ferns.	3	Rally 40W	5 oz	180	6 app	Apply only to fern stage. Begin at first appearance of disease. Rally and tebuconazole should be alternated with non-Group 3 fungicides. Jersey male hybrids are resistant to rust.
	3	tebuconazole 3.6F	4 - 6 fl oz	180	3 app	
	M	mancozeb 80WP[4]	2 lb	180	8 lb	
	M	chlorothalonil 6L[4]	2 - 4 pt	190	12 pt	
	M	sulfur	See label	0	NL	
Cercospora leaf spot (blght) Tan spots with purple margins.	3	mancozeb 80WP[4]	2 lb	180	8 lb	Apply only to fern stage. Apply mancozeb at 10-day intervals, beginning at first appearance of disease. The minimum re-treatment interval for chlorothalonil is 14 days.
	M	chlorothalonil 6L[4]	2 - 4 pt	190	12 pt	
Fusarium crown and root rot Deterioration of root system and poor growth of plants.	M	mancozeb 80WP[4]	1 lb/100 gal Preplant root dip.			See label. Chemical control is limited. Avoid acidic and poorly drained soils. Avoid excessive cutting. Jersey male hybrids tolerant.
Stemphyllium purple spot Purple lesions with brown centers on spears and ferns.	11	Quadris 2.08F	6.2 - 15.4 fl oz	100	92 fl oz	Do not make more than 1 application of Quadris or Flint before alternating with a fungicide with a different mode of action. Remove and destroy fern debris in fall.
	11	Flint 50WG	3 - 4 oz	180	3 app	
	M	chlorothalonil 6L[4]	2 - 4 pt	190	12 pt	
BEAN, SNAP						
Alternarial leaf and pod spot Dark flecks on pods and leaves, and large brown leaf spots.	2	iprodione 4F	1.5 - 2 pt	*	2 app	Alternate with a fungicide with a different mode of action after each application of Headline, Quilt or Quadris or 2 consecutive apps of Fontelis. See Priaxor label for tank mix warnings. *Apply no later than peak bloom.
	3,11	Quilt 1.66SC	14 fl oz	7	3 app	
	7,11	Priaxor 4.17SC	4 - 8 fl oz	7	2 app	
	7	Fontelis 1.67SC	14 - 30 oz	0	72 fl oz	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
	11	Headline 2.09	6 - 9 fl oz	7	2 app	
Anthracnose Dark, sunken spots on pods and stems with pinkish ooze.	1	thiophanate methyl 70WG	1.375 - 3 pt	7	12 pt	Use Western-grown seed. If plants become infected, do not work in fields while plants are wet. Spray at 7- to 10-day intervals. Alternate with a fungicide with a different mode of action after each application of Headline, Quilt or Quadris or 2 consecutive apps of Fontelis. See Priaxor label for tank mix warnings.
	3,11	Quilt 1.66SC	14 fl oz	7	3 app	
	7,11	Priaxor 4.17SC	4 - 8 fl oz	7	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	0	72 fl oz	
	11	Headline 2.09F	6 - 9 fl oz	7	2 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
	M	chlorothalonil 6L[4]	1.375 - 3 pt	7	12 pt	
Bacterial blights Water-soaked spots on leaves and pods. Red margin and sometimes a yellow halo around spot.	M	fixed copper	See label	0	NL	Use Western-grown seed. If plants become infected, do not work in fields while plants are wet.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
BEAN, SNAP (CONT'D)						
Gray mold (Botrytis) Gray moldy growth on pods and stems.	1	thiophanate methyl 70WP	1.5 - 2 lb	14	4 lb	Begin at 10 - 25% bloom. Repeat at peak bloom. Rotate to a different mode of action. See label for frequency of required rotation. See Priaxor label for tank mix warnings. *Apply no later than peak bloom.
	2	iprodione 4F	2 pt	*	2 app	
	7	Endura 70 WG	8 - 11 oz	7	2 app	
	7,11	Priaxor 4.17SC	4 - 8 fl oz	7	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	0	72 fl oz	
	9,12	Switch 62.5 WG	11 - 14 oz	7	56 oz	
	12	Cannonball 50WP	7 oz	7	28 oz	
	29	Omega 4.17SC	0.5 - 0.85 pt	14	1.75 pt	
	M	chlorothalonil 6L	3 pt	7	12 pt	
Mosaic viruses Leaves yellowed, crinkled or speckled. Leaves cupped, runners killed.						Use resistant varieties. Half runners are most susceptible, particularly "Pink." Make successive plantings, as mosaic is more severe at certain times of the year.
Pod tip rot (Rhizoctonia)	3	Rally 40WP	4 - 5 oz	0	20 oz	Begin applications when pods begin to develop. Repeat at 7- to 10-day intervals if conditions remain favorable.
Powdery mildew White, powdery mold on surface of leaves.	7	Endura 70WG	8 - 11 oz	7	2 app	Alternate with a fungicide with a different mode of action after each application of Headline or 2 consecutive apps of Fontelis. See Priaxor label for tank mix warnings. Use resistant varieties.
	7,11	Priaxor 4.17 SC	4 - 8 fl oz	7	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	0	72 fl oz	
	11	Headline 2.09F	6 - 9 fl oz	7	2 app	
	M	sulfur	see label	0	NL	
Rusts Reddish-bronze pustules on leaves, stems and pods.	3	Rally 40W	4 - 5 oz	0	20 oz	Spray plants when rust first appears and repeat at 7- to 10-day intervals. Alternate with a fungicide with a different mode of action after each application of Headline, Quilt or Quadris or 2 consecutive apps of Fontelis. See Priaxor label for tank mix warnings.
	3	tebuconazole 3.6F	4 - 6 fl oz	7	24 fl oz	
	3,11	Quilt 1.66SC	14 fl oz	7	3 app	
	7	Endura 70WG	8 - 11 oz	7	2 app	
	7,11	Priaxor 4.17 SC	4 - 8 fl oz	7	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	0	72 fl oz	
	11	Headline 2.09F	6 - 9 fl oz	7	2 app	
	11	Quadris 2.08F	6.2 fl oz	0	92 fl oz	
	M	chlorothalonil 6L[4]	3 pt	7	12 pt	
Seedling disease Rots of seeds and death of seedlings (damping off) and root rots.		*For Rhizoctonia and Pythium:*				Ridomil Gold PCGR, Blocker and Terraclor are in-furrow applications. Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Rotate fields, avoid double-cropping beans and turn under plant debris well in advance of planting. See UT Extension publication SP 277-O.
	4,14	Ridomil Gold PCGR	0.75 lb/1000 row ft			
	4,11	Uniform 3.72SC	0.34 fl oz/1000 row ft			
		For Rhizoctonia only:				
	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			
	14	Blocker 4F	2 - 3 pt			
	14	Terraclor 75WP	2 lb in 10 gal water			
White mold (Sclerotinia) White moldy growth on pods and stems.	1	thiophanate methyl 70WG	1 - 1.5 lb	14	4 lb	Spray at 10 - 25% bloom; repeat at full bloom. Botran may be applied at 7-day intervals. Rotate to a different mode of action. Refer to product labels for frequency of rotation required. *Apply no later than peak bloom.
	2	iprodione 4F	1.5 - 2 pt	*	2 app	
	7	Endura 70WG	8 - 11 oz	7	2 app	
	7	Fontelis 1.67SC	16 - 30 fl oz	0	72 fl oz	
	12	Cannonball 50WP	7 oz	7	28 oz	
	12,9	Switch 62.5 WG	11 - 14 oz	7	56 oz	
	14	Botran 75WP	2.67 lb	2	5.33 lb	
	29	Omega 4.17SC	0.5 - 0.85 pt	14	1.75 pt	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
BEAN, DRY (Navy, Pinto, Kidney, Lima, Southern pea, etc.)						
Anthracnose Dark brown to brick-red spots on stems and pods.	1	thiophanate methyl 70WG	1 - 2 lb	28	4 lb	Begin applications during early bloom stage and repeat at 7- to 10-day intervals. Refer to Priaxor, Quadris, Quadris Opti, Quilt, Vertisan and Headline labels for resistance management guidelines. See Priaxor label for tank mix warnings.
	3,11	Quilt 1.66SC	14 fl oz	14	3 app	
	7	Vertisan 1.67EC	14 - 20 fl oz	21	41 fl oz	
	7,11	Priaxor 4.17SC	4 - 8 fl oz	21	2 app	
	11	Headline 2.09F	6 - 9 fl oz	21	2 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	14	92 fl oz	
	M	chlorothalonil 6L[4]	1.375 - 2 pt	14	8 pt	
	M,11	Quadris Opti 5.5SC	1.6 - 2.4 pt	14	4 app	
Gray mold (Botrytis) Gray, moldy growth on pods and stems.	1	thiophanate methyl 70WG	1- 2 lb	21	4 lb	Begin applications during early bloom stage and repeat at 7- to 10-day intervals. Rotate to a different mode of action after 2 applications of Switch. See Priaxor label for tank mix warnings. *Apply no later than peak bloom.
	2	iprodione 4F	1.5 - 2 pt	*	2 app	
	7	Endura 70 WG	8 - 11 oz	21	2 app	
	7	Vertisan 1.67EC	14 - 20 fl oz	21	41 fl oz	
	7,11	Priaxor 4.17SC	4 - 8 fl oz	21	2 app	
	12	Cannonball 50WP	7 oz	14	28 oz	
	12,9	Switch 62.5 WG	11 - 14 oz	14	56 oz	
	29	Omega 4.17SC	0.5 - 0.85 pt	30	1.75 pt	
Rusts Reddish-bronze pustules.	3	tebuconazole 3.6F	4 - 6 fl oz	14	12 fl oz	Begin applications when conditions become favorable for rust and repeat at 7- to 10-day intervals. Refer to Quadris, Quadris Opt, Quilti and Headline labels for resistance management guidelines. See Priaxor label for tank mix warnings.
	3,11	Quilt 1.66SC	14 fl oz	14	3 app	
	7	Endura 70WG	8 - 11 oz	21	2 app	
	7	Vertisan 1.67EC	14 - 20 fl oz	21	41 fl oz	
	7,11	Priaxor 4.17 SC	4 - 8 fl oz	21	2 app	
	11	Headline 2.09F	6 - 9 fl oz	21	2 app	
	11	Quadris 2.08F	6.2 - 15.2 fl oz	14	92 fl oz	
	M	chlorothalonil 6L[4]	1.375 - 2 pt	14	8 pt	
BEAN, LIMA						
Anthracnose Reddish-brown spots on leaves, pods and stems.	1	thiophanate methyl 70WG	1 - 2 lb	7	2 app	Plant disease-free seed and rotate lima beans with other crops. Start applications of fungicide at first bloom and continue at 7- to 10-day intervals. Alternate Quadris with a different mode of action.
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
Seedling disease Rots of seeds and death of seedlings (damping off) and root rots.		*For Rhizoctonia and Pythium:*				Ridomil Gold PCGR, Blocker and Terraclor are in-furrow applications. Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Rotate fields, avoid double-cropping beans and turn under plant debris well in advance of planting. See UT Extension publication SP 277-O.
	4,14	Ridomil Gold PCGR	0.75 lb/1000 row ft			
	4,11	Uniform 3.72SC	0.34 fl oz/1000 row ft			
		For Rhizoctonia only:				
	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			
	14	Blocker 4F	2 - 3 pt			
	14	Terraclor 75WP	2 lb in 10 gal water			
White mold (Sclerotinia) White moldy growth on pods and stems.	1	thiophanate methyl 70WG	1 - 2 lb	14	4 lb	Spray at 10 - 25% bloom; repeat at full bloom. Rotate to a different mode of action. See product label for frequency of rotation required. * Apply no later than peak bloom.
	2	iprodione 4F	1.5 - 2 pt	*	2 app	
	7	Endura 70WG	8 - 11 oz	7	2 app	
	7	Fontelis 1.67SC	16 - 30 fl oz	0	72 oz	
	12	Cannonball 50WP	7 oz	7	28 oz	
	12,9	Switch 62.5 WG	11 - 14 oz	7	56 oz	
	29	Omega 4.17SC	0.5 - 0.85 pt	14	1.75 pt	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
BEET						
Rust Bronze pustules.	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	Spray at first appearance and repeat at 7- to 10-day intervals; 14-day intervals for tebuconazole. Rotate to a non-related fungicide after each application of Gem, Cabrio or Quadris and after 2 consecutive apps of Fontelis.
	11	Gem 4.17SC	1.9 - 2.9 fl oz	7	4 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
	M	sulfur	See label	0	NL	
Leaf spots Various leaf spots.	3	tebuconazole 3.6F	3 - 7.2 fl oz	7	28 fl oz	
	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	123 fl oz	
	11	Cabrio 20EG	8 - 12 oz	0	3 app	
	11	Gem 4.17SC	1.9 - 2.9 fl oz	7	56 fl oz	
Pythium Damping off and root rot.	4	Ridomil Gold SL	1 - 2 pt/treated acre	NA	1 app	Apply only before planting (incorporated into top 2 inches of soil) or at planting on surface. May be broadcast or banded.
	4	MetaStar 2E AG	4 - 8 pt/treated acre	NA	1 app	
	4	Ultra Flourish	2 - 4 pt/treated acre	NA	1 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	Apply at planting as a soil spray.
BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER						
Alternarial leaf spot Target spots on older leaves. Small, black spots may also occur.	3	Procure 4L	6 - 8 fl oz	1	18 fl oz	Apply on 7- to 14-day intervals until disease is under control. Refer to product labels for resistance management guidelines for Endura, Cabrio, Fontelis, Inspire Super, Quadris, Quadris Top and Switch. Mancozeb only for broccoli and cabbage. Not all mancozeb products are labeled for these crops; check label.
	4,M	Ridomil Gold Bravo SC	1.5 pt	7	4 app	
	7	Endura 70WG	6 - 9 oz	0	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	3	72 fl oz	
	9,3	Inspire Super	16 - 20 fl oz	7	80 fl oz	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
	11	Cabrio 20EG	12 - 16 oz	0	4 app	
	11,3	Quadris Top	14 fl oz	1	56 fl oz	
	12,9	Switch 62.5EG	11 - 14 oz	7	56 oz	
	M	chlorothalonil 6L[4]	1.5 pt	0	16 pt	
	M	mancozeb 75DF	1.6 - 2.1 lb	7	12.8 lb	
Downy mildew Yellow leaf spots with gray flecks.	4,M	Ridomil Gold Bravo SC	1.5 pt	7	4 app	Actigard must be used preventively and repeated at 7-day intervals. Other materials: 7- to 10-day intervals until disease is under control. Do not make more than 1 application of Quadris, Ranman or Reason or 2 consecutive apps. of Cabrio, Presidio, Revus or Zampro before alternating with a fungicide with a different mode of action. Use adjuvant with Revus and Ranman. **Mancozeb only for broccoli and cabbage**. Not all mancozeb products are labeled for these crops; check label.
	11	Cabrio 20EG	12 - 16 oz	0	4 app	
	11	Reason 4.13 SC	5.5 - 8.2 fl oz	2	24.6 fl oz	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
	21	Actigard 50WG	1 oz	7	4 oz	
	21	Ranman 3.33SC	2.75 fl oz	0	6 app	
	33	Aliette 80WG	2 - 5 lb	3	7 app	
	40	Revus 2.08SC	8 fl oz	1	4 app	
	40,45	Zampro 4.33SC	14 fl oz	0	42 fl oz	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	M	chlorothalonil 6L[4]	1.5 pt	0	16 pt	
	M	mancozeb 75DF	1.6 - 2.1 lb	7	6 app	
	M	Mankocide 61.1DF	1 - 3 lb	7	8.8 lb	
Black leg Lower stem turns brown and rots causing a canker.	2	iprodione 4F (Broccoli only)	2 pt	0	2 app	Use certified disease-free seeds or transplants. Direct spray to base of plant and adjacent soil surface.
Black rot Yellow to brown, V-shaped spots on edge of leaves.	P1	Actigard 50WG	1 oz	7	4 oz	Use certified disease-free seeds or transplants. Use tolerant varieties of cabbage. See Extension publication SP 277-P. Wait 7-10 days after thinning or transplanting to apply Actigard. Mankocide for broccoli and cabbage only.
	M	fixed copper	see label	0	label	
	M	Mankocide 61.1DF	1 - 3 lb	7	8.8 lb	
Bacterial soft rot Dark, soft rot. Favored by hot, wet conditions.						Control of black rot will also help control bacterial soft rot. Avoid mechanical damage to the crop.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER (CONT'D)						
Rhizoctonia damping off and wire stem Seedlings die; young plants stunted; stem hard and constricted.		transplant seedbed				
	14	Terraclor 75WP	4 - 8 oz/100 gal water			Use this volume on 400 - 800 sq ft. Can be repeated once 4 - 6 weeks later.
		field				Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Terraclor sprayed as 8-inch band on the row at the time of or immediately after seeding.
	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			
	14	Terraclor 75WP	12.2 - 18.8 oz/1000 row ft			
Pythium damping off Dark rot of roots and stem	4	Ridomil Gold SL	0.25 - 0.5 pt	NA	1 app	Apply preplant incorporated into top 2 inches or at planting as a soil spray or in drip irrigation.
	4	MetaStar 2E AG	1 - 2 pt	NA	1 app	
	4	Ultra Flourish	0.5 - 1 pt	NA	1 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	Apply at planting/transplanting as a soil spray.
Club root Galls or clubs on roots. Plants are pale and stunted.	NC	hydrated lime	1500 lb			Broadcast and work lime into soil by disking within 3 days before planting. Ranman and Terraclor applied as transplant solutions at 1.7 fl oz and ½ pt per plant, respectively.
	21	Ranman 3.33SC	13 - 25 fl oz/100 gal			
	14	Terraclor 75WP	2 lb/100 gal			
Powdery mildew White, powdery growth on leaves.	3	Procure 4L	6 - 8 fl oz	1	18 fl oz	Apply when disease first appears; continue at 7- to 14-day intervals. See product labels for resistance management guidelines.
	7	Endura 70WG	6 - 9 oz	0	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	3	72 fl oz	
	9,3	Inspire Super	16 - 20 fl oz	7	80 fl oz	
	11	Cabrio 20 EG	12 - 16 fl oz	0	4 app	
	11,3	Quadris Top	14 fl oz	1	56 fl oz	
	12,9	Switch 62.5WG	11 - 14 oz	7	56 oz	
Rhzoctonia bottom rot Rot begins at lower part of head.	7	Endura 70WG	6 - 9 oz	0	2 app	Begin applications prior to disease development.
White mold (Sclerotinia) Soft, wet rot and white fungal growth on head.	7	Endura 70WG	6 - 9 oz	0	2 app	Begin applications prior to disease development.
	7	Fontelis 1.67SC	16 - 30 fl oz	3	72 fl oz	
CANTALOUPE - See MELONS						
CARROT						
Alternaria blight Numerous dark brown spots which may coalesce.	2	iprodione 4F	1 - 2 pt	0	4 app	Spray at first appearance and repeat at 7- to 10-day intervals. Alternaria blight can spread rapidly. Refer to Fontelis, Quadris, Quadris Opti, Cabrio, Endura, Pristine, trifloxystrobin and Switch labels for resistance management guidelines.
	7	Endura 70WG	8 - 11 oz	0	5 app	
	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	
	11	Cabrio 20EG	8 - 12 fl oz	0	3 app	
	11	Quadris 2.08F	9 - 15.5 fl oz	0	123 fl oz	
	11	trifloxystrobin				
		Flint 50WG	2 - 3 oz	7	4 app	
		Gem 4.17SC	1.9 - 2.9 fl oz	7	4 app	
	11,3	Quadris Top 2.72SC	12 - 14 fl oz	7	56 fl oz	
	11,7	Pristine 38WG	8 - 10.5 oz	0	6 app	
	11,M	Quadris Opti 5.5SC	2.4 pt	0	6 app	
	12,9	Switch 62.5WG	11 - 14 oz	7	56 oz	
	29	Omega 4.17SC	1 pt	7	4 app	
	M	chlorothalonil 6L[4]	1.5 - 2 pt	0	20 pt	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
CARROT (CONT'D)						
Cercospora leaf spot Small, dark brown to black spots on leaves.	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	
	11	Cabrio 20EG	8 - 12 oz	0	3 app	
	11	Quadris 2.08F	9 - 15.5 fl oz	0	123 fl oz	
	11	trifloxystrobin				
		Flint 50WG	2 - 3 oz	7	4 app	
		Gem 4.17SC	1.9 - 2.9 fl oz	7	4 app	
	11,3	Quadris Top 2.72SC	12 - 14 fl oz	7	4 app	
	11,3	Quilt 1.66SC	14 fl oz	14	55 fl oz	
	11,7	Pristine 38WG	8 - 10.5 oz	0	6 app	
	11,M	Quadris Opti 5.5 SC	2.4 pt	0	6 app	
	M	chlorothalonil 6L[4]	1.5 - 2 pt	0	20 pt	
Southern blight White fungal growth on lower stem.		SMDC	See Table 3	NA	1 app	SMDC and Telone C35 are pre-plant soil fumigants. Fontelis, Omega and Quadris Top are foliar sprays, applied at 7- to 14-day intervals. See labels for resistance management programs.
		Telone C35	See Table 3	NA	1 app	
	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	
	11,3	Quadris Top 2.72SC	12 - 14 fl oz	7	4 app	
	29	Omega 4.17SC	1 pt	7	4 app	
CAULIFLOWER (SEE BROCCOLI)						
COLLARD, MUSTARD, KALE						
Alternaria leaf spot Dark brown leaf spots.	3	tebuconazole 3.6F	3 - 4 fl oz	7	16 fl oz	Begin applications prior to disease onset and follow 7- to 10-day schedule during rainy weather. Maintain thin plant stand and avoid low-lying or poorly drained soils. See labels for resistance management guidelines for all products other than copper. **Endura, Fontelis and Switch not for Cercospora.**
	7	Endura 70WG	6 - 9 oz	14	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	3	72 fl oz	
	9,3	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
Cercospora leaf spot Tan leaf spots with yellow haloes.	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	46 fl oz	
	11,3	Quadris Top	12 - 14 fl oz	1	56 fl oz	
	12,9	Switch 62.5WG	11 - 14 oz	7	56 oz	
	M	fixed copper	see label	0	NL	
Downy mildew Yellow leaf spots with white to gray mold on underside.	4	Ridomil Gold SL	0.125 - 0.25 pt	7	4 app	Actigard must be used preventively and repeated at 7-day intervals. Other materials: 7- to 10-day (14, for Ridomil) intervals until disease is under control. Do not make more than 1 app. of Reason or Ranman or 2 apps. of dimethomorph, Revus or Zampro before alternating with a fungicide with a different mode of action. Forum, Presidio and Ridomil must be tank mixed with a fungicide with a different mode of action. Use adjuvant with Revus. Do not tank mix Aliette with copper fungicides.
	11	Reason 4.13 SC	5.5 - 8.2 fl oz	2	24.6 fl oz	
	21	Ranman 3.33SC	2.75 fl oz	0	6 app	
	33	Aliette 80WDG	3 - 5 lb	3	7 app	
	40	Forum 4.18F	6 fl oz	0	5 app	
	40	Revus 2.08SC	8 fl oz	1	4 app	
	40,45	Zampro 4.33SC	14 fl oz	0	42 fl oz	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	M	fixed copper	see label	1	NL	
	P1	Actigard 50WG	1 oz	7	4 oz	
Powdery mildew White, powdery growth on leaves.	3	Procure 4SC	6 - 8 fl oz	1	18 fl oz	Apply when disease first appears; continue at 7- to 14-day intervals if needed. Sulfur not for Alternaria. See labels for resistance management guidelines for all products other than sulfur.
	3	tebuconazole 3.6F	3 - 4 fl oz	7	16 fl oz	
	7	Endura 70WG	6 - 9 oz	0	2 app	
	7	Fontelis 1.67SC	14 - 30 fl oz	3	72 fl oz	
Alternaria leaf spot Dark brown leaf spot	9,3	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
	11,3	Quadris Top	14 fl oz	1	56 fl oz	
	12,9	Switch 62.5WG	11 - 14 oz	7	56 oz	
	M	sulfur	see label	0	NL	
Rhizoctonia bottom rot Firm rot of stem.	7	Endura 70WG	6 - 9 oz	0	2 app	Begin applications prior to disease development. Fontelis not for Rhizoctonia.
	7	Fontelis 1.67SC	16 - 3- fl oz	3	72 fl oz	
Sclerotinia stem rot Soft rot of stem with white mold.						

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
CORN, SWEET						
Blights Spots on leaves and drying or blighting of leaves. **Rusts** Bronze, elongate spots.	3	propiconazole 3.6EC	2 - 4 fl oz	14	16 fl oz	Begin applications when conditions favor disease development and repeat at 7- to 10-day intervals. Quilt and propiconazole applied on 7- to 14-day schedule. Waiting time for use as livestock forage: 0 days for Vertisan, 7 days for Priaxor, 14 days for propiconazole and Stratego. Sweet corn treated with other listed products cannot be used as orage. See Quilt, Priaxor, Quadris, Stratego, Vertisan or Headline label for resistance management guidelines. See Priaxor for tank mix warnings. ***Chlorothalonil for fresh market only.**
	7	Vertisan 1.67EC	10 - 24 fl oz	7	48 fl oz	
	11	Headline 2.09F	0.75 - 2 pt	14	12 pt	
	11	Quadris 2.08F	6 - 12 fl oz	7	6 app	
	11,3	Quilt 1.66SC	6.2 - 9 fl oz	7	123 fl oz	
	11,3	Stratego 2.08SC	10.5 - 14 fl oz	14	56 fl oz	
	11,7	Priaxor 4.17SC	4 - 8 fl oz	7	2 app	
	M	mancozeb 80WP[4]	10 fl oz	14	30 fl oz	
	M	chlorothalonil 6L[4]*	1.5 lb	7	22.5 lb	
Maize dwarf mosaic Plants stunted, leaves reddened or yellowed.						Plant early and avoid fields heavily infested with johnsongrass. Plant tolerant varieties if johnsongrass is present.
Stewart's wilt Brown streaks in leaves parallel to veins.						Control corn flea beetle. See insect control section of this publication.
CUCUMBER, FIELD (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Angular leaf spot Brown, angular spots that usually fall out.	P1	Actigard 50WG	0.5 - 1 oz	0	8 oz	Spray at first appearance and repeat at 7- to 14-day intervals. Copper can injure young plants. Avoid applying Actigard to stressed plants. Plant resistant varieties.
	M	fixed copper	see label	0	label	
Bacterial wilt Individual runners wilt; later, entire plant wilts and dies.						Apply insecticide to control cucumber beetles, which spread the disease. See insect control section of this publication.
Belly rot Soft, sunken rot on side of fruit in contact with soil.	M 1	chlorothalonil 6L[4] + thiophanate methyl 70WG	2 pt 0.5 lb	0 0	21 pt	Applied to foliage every 7 - 10 days, beginning at vine tip-over.
	11	Quadris 2.08F	11 - 15.4 fl oz	1	92 fl oz	Apply at the 1- to 3-leaf stage and again just prior to vine tip-over or 10 - 14 days later, whichever comes first.
Alternaria leaf spot Tan target spots on leaves, followed by blighting. **Anthracnose** Sunken spots on fruit and tan leaf spots. **Downy mildew** Large, yellow spots that turn necrotic. **Gummy stem blight** Brown leaf spots. Cracks on stems with gummy ooze.	7	Fontelis 1.67SC	12 - 16 fl oz	1	67 fl oz	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Pristine, Quadris, Quadris Top or Quadris Opti; these products should be alternated with non-Group 11 fungicides. Rotate to a different mode of action after 2 applications of Switch, Fontelis or Inspire Super. See Cabrio, Quadris and Quadris Opti labels for restrictions on tank mix partners. **Sovran not for alternaria, anthracnose or downy mildew. Switch and Fontelis not for anthracnose or downy mildew. Inspire Super not for downy mildew.**
	9,3	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
	11	Cabrio 20EG	12 - 16 oz	0	4 app	
	11	Quadris 2.08F	11 - 15.4 fl oz	1	92 fl oz	
	11	Sovran 50WG	4.8 oz	0	4 app	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
	11,7	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	11,M	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	12,9	Switch 62.5WG	11 - 14 oz	1	56l oz	
	M	chlorothalonil 6L[4]	1.5 - 3 pt	0	21 pt	
	M,4	Ridomil Gold Bravo SC	2.5 - 3.25 pt	0	4 app	
	M,4	Ridomil Gold MZ	2.5 lb	5	4 app	

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
CUCUMBER, FIELD (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Downy mildew (Additional products)	11	Reason 4.13F	5.5 fl oz	14	4 app	Begin applications prior to infection, 7- to 10-day spray schedule. Shorten spray intervals when downy mildew is active. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil or mancozeb. See label. Presidio, applied through drip irrigation for soilborne disease control, will provide some control of downy mildew.
	11	Tanos 50WG	8 oz	3	4 app	
	21	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	22,M	Gavel 75DF	1.5 - 2 lb	5	8 app	
	27	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	28	Previcur Flex 6F	1.2 pt	2	6 pt	
	40	Revus 2.08SC	8 fl oz	0	4 app	
	40	Forum 4.18F	6 fl oz	0	5 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Phytophthora blight Rot of fruit covered with thin, white mold.	21	Ranman 3.33SC	2.75 fl oz	0	6 app	Forum, Presidio, Ranman, Revus and Zampro must be involved in resistance management programs. Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2- to 4-week intervals (see label). Although not labeled for Phytophthora blight, **copper fungicides** have been shown to be helpful in suppressing this disease.
	33	phosphorous acid:	6 fl oz	0	5 app	
		Agri-Fos	8 fl oz	0	4 app	
		Fosphite	3 - 4 fl oz	2	12 fl oz	
		ProPhyt				
		Phostrol	1.25 qt/A	0	6 app	
	40	Forum 4.18F	1 - 3 qt	0	NL	
	40	Revus 2.08SC	1 - 3 qt	0	NL	
	43	Presidio 4SC	2.5 - 5 pt	0	7 app	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Powdery mildew White, powdery mold on surface of leaves.	3	tebuconazole 3.6F	4 - 6 fl oz	7	24 fl oz	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products when powdery mildew appears. Do not apply sulfur if temperatures exceed 90 F. Thorough coverage is critical for chlorothalonil and sulfur. All other fungicides must be rotated to a different mode of action after the second consecutive application. Allow at least 14 days between Torino applications. **Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.**
	3	Rally 40W	2.5 - 5 oz	0	24 oz	
	3	Procure 50WP	4 - 8 oz	0	40 oz	
	7	Fontelis 1.67SC	12 - 16 fl oz	1	67 fl oz	
	9,3	Inspire Super 2.82SC	16 - 12 fl oz	7	80 fl oz	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
	11,7	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	12,9	Switch 52.5WG	11 - 14 oz	1	56 oz	
	M	chlorothalonil 6L[4]	2 - 3 pt	0	21 pt	
	M	sulfur	see label	0	NL	
	M,11	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	U	Torino 0.85SC	3.4 oz	3	6.8 oz	
Scab Sunken spots on fruit.	M	chlorothalonil 6L[4]	2 - 3 pt	0	21 pt	Resistant varieties widely available.
	M	mancozeb 80WP[4]	2 - 3 lb	5	25.6 lb	
	M,4	Ridomil Gold/Bravo	2 - 3 lb	0	4 app	
Seedling disease Failure of seedlings to emerge or death after emergence.		*Rhizoctonia:*				Quadris: Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Ridomil Gold: Apply preplant incorporated, as surface band or through drip irrigation. Previcur Flex: Applied via transplant water, drip irrigation, sprinklers or directed to lower portion of plants and soil.
	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			
		Pythium:				
	4	Ridomil Gold 4SL	1 - 2 pt/treated acre	--	1 app	
	28	Previcur Flex 6F	1.2 pt	2	6 pt	
CUCUMBER, GREENHOUSE						
Angular leaf spot, downy mildew, powdery mildew	M	fixed copper	See label	0	NL	Apply weekly, beginning when plants begin to vine.
Anthracnose, Cercospora leaf spot, downy mildew, scab, target spot	M,33	Catamaran	4 pt/43,560 sq ft	1	50 pt	Spray at first appearance of disease, repeat at weekly intervals. Observe label precautions for Catamaran.
	M	mancozeb 80WP[4]	1.5 - 2 lb/100 gal	5	25.6 lb	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
CUCUMBER, GREENHOUSE (CONT'D)						
Gummy stem blight, Alternaria leaf blight	12,9	Switch 62.5WG	11 - 14 oz/43,560 ft^2	1	56 oz	Spray at first appearance of disease, repeat at weekly intervals. Observe label precautions for Catamaran. Rotate to a different mode of action after the second application of Switch.
	M	mancozeb 80WP[4]	1.5 - 2 lb/100 gal	5	25.6 lb	
	M,33	Catamaran	6 pt/43,560 ft^2	1	50 pt	
Gummy stem blight, anthracnose, target spot	1	3336 70WP (transplant production only)	0.7 lb/43,560 ft^2	NA	4.2 lb	Apply at 7- to 14-day intervals, alternating with non-related fungicides.
Powdery mildew	3	Procure 4L (transplant prodution only)	4 - 8 fl oz/43,560 ft^2	NA	40 fl oz	Spray at first sign of disease and repeat at 14-day intervals, if needed. Do not apply Microthiol Disperss if temps will exceed 90 F within the 3 days following spraying. Rotate to a different mode of action after the second application of Switch and after each application of Verands. 3336 70WP can be used in transplant production, but resistance in this fungus is common.
	3	Rally 40WP	2.5 - 5 oz/43,560 ft^2	0	24 oz	
	7	Fontelis 1.67SC	0.75 - 1 TBSP/ gal/1360 ft^2	1	2.1 fl oz/ 1360 sq ft	
	12,9	Switch 62.5WG	11 -14 oz/43,560 ft^2	1	56 oz	
	19	Veranda O 11.3WG	6.2 oz/43,560 ft^2	0	5 app	
	M	Microthiol Disperss	2 lb/43,560 ft^2	0	NL	
Pythium root rot	28	Previcur Flex	see label		6 app	Applied as a root drench. See label for use directions.
Sclerotinia white mold	7	Fontelis 1.67SC	1 TBSP/gal/1360 ft^2	1	2.1 fl oz/ 1360 sq ft	Botran may be re-applied after 14 days. Contans is a biological. Apply to soil about 3 months prior to planting. Till 2 in. to 8 in. deep. After 2 consecutive apps of Fontelis, rotate with Botran.
	14	Botran 75WP	1.33 lb/100 gal	1	1.33 lb	
	NC	Contans WG	0.75 - 1.5 oz/1000 ft^2	NA	NL	
EGGPLANT						
Leaf blights, fruit rots Various spots on leaves and fruits.	7	Fontelis 1.67SC	10 - 24 fl oz	0	72 fl oz	Begin spraying when disease is expected and repeat at 7- to 10-day intervals. See Quadris, Flint, Cabrio, Fontelis and Priaxor labels for resistance management guidelines. See Priaxor label for tank mix warnings.
	7,11	Priaxor 4.17SC	4 - 8 fl oz	7	3 app	
	11	Cabrio 20EG	8 - 12 oz	0	96 oz	
	11	Flint 50WG	3 - 4 fl oz	3	5 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	61 fl oz	
	M	fixed copper	See label	0	NL	
	M	Bravo Weather Stik 6SC	1.5 pt	3	12 pt	
Phytophthora blight - crown and root phase Rapid wilt and death of plants in wet areas of field.	4	Ridomil Gold EC	1 pt/treated acre	7	3 app	Plant on raised beds, improve field drainage, and do not plant wet areas. Crown and root phase is caused by root infections. Ridomil Gold and Ultra Flourish are soil-applied at planting and up to 2 supplemental applications at 30-day intervals. Apply Ranman in transplant water or direct to base of plant at time of transplanting. Apply Presidio as a soil spray or in drip irrigation. Apply Zampro at planting in drip or as spray directed to plant base and root zone.
	4	Ultra Flourish	2 pt/treated acre	7	3 app	
	21	Ranman 3.33SC	2.75 fl oz	0	6 app	
	33	phosphorous acid: Fosphite	Pre-plant root dip: 2 qt/100 gal Drip irrig.: 2-3 qt in at least 100 gal	0	NL	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC.	14 fl oz	4	42 fl oz	
Phytophthora blight - fruit phase Liver-colored rot of fruit.	40	Forum 4.18F	6 fl oz	0	5 app	Forum, Presidio, Ranman and Zampro are foliar-applied every 7 - 10 days as a tank mix with and alternated with products with a different mode of action. Agri-Fos is foliar-applied every 21 days; Fosphite, every 2 - 4 weeks (see label). Although not labeled for Phytophthora blight, **copper** sprays have been shown to be helpful in suppressing this disease.
	33	phosphorous acid:				
		Agri-Fos	1.25 qt	0	6 app	
		Fosphite	1-3 qt	0	NL	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	21	Ranman 3.33SC	2.75 fl oz	0	6 app	
	45,40	Zampro 4.33SC	14 fl oz	4	42 fl oz	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
GINSENG						
Phytophthora root rot and leaf blight Wilt, soft rot of root, wet blight of leaves.	4	Ridomil Gold EC	0.75 pt	NA	1 app	Begin Aliette in spring, continue at 7-day intervals. Mix in at least 100 gal water/A. Apply Ridomil Gold EC or MetaStar in 100 - 400 gal water to soil surface in spring before plants begin growing.
	4	Ridomil Gold GR	15 lb	9	60 lb	
	4	MetaStar 2E AG	1.5 qt	NA	1 app	
	33	Aliette/Linebacker 80WG	5 lb	31	9 app	
Alternaria leaf spot Tan leaf spots.	2	iprodione 4F	1.5 - 2 pt	36	5 app	Spray first appearance and repeat at 7- to 10-day intervals. All of these products other than Bravo and mancozeb must be involved in resistance management programs. See labels for details.
	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	
	11	Gem 4.17SC	1.9 - 2.9 fl oz	7	4 app	
	11	Quadris 2.08F	6.2 - 15.5 fl oz	0	123 fl oz	
	11	Cabrio 20EG	8 - 12 oz	0	3 app	
	12,9	Switch 62.5WG	11 - 14 oz	7	56 oz	
	29	Omega 4.17SC	1 - 1.5 pt	30	6 pt	
	M	mancozeb 80WP[4]	2 lb	30	12 app	
	M	Bravo Weather Stik 6SC	1.5 pt	3	12 pt	
Seedling disease Failure of seedlings to emerge or death after emergence.	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates if disease pressure is high.
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	For Pythium only. Apply at planting/ transplanting as a soil spray or in drip irrigation.
KALE (SEE COLLARD)						
LETTUCE, FIELD						
Bottom rot (Rhizoctonia) Wet, brown rot begins on lower leaves and progresses into head.	2	iprodione 4F	1.5 - 2 pt	14	3 app	Apply at 3-leaf stage to just after thinning and repeat at 10-day intervals, if needed. Direct nozzles to cover lower part of plants and surrounding soil surface. Do not disturb soil after spraying.
	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high.
Botrytis rot Gray, fuzzy mold.	2	iprodione 4F	1.5 - 2 pt	14	3 app	Apply when conditions are favorable for infection. Botran rate depends on timing; see label. Rotate Fontelis and Cannonball to a different mode of action after 2 consecutive apps.
	7	Endura 70WG	8 - 11 oz	14	2 app	
	7	Fontelis 1.67SC	14 - 24 fl oz	3	72 fl oz	
	12	Cannonball 50WP	7 oz	0	28 oz	
	14	Botran 75WP	2 - 5.3 lb	14	5.3 lb	
Drop (Sclerotinia) Wet rot of head with white, cottony mold.	2	iprodione 4F	1.5 - 2 pt	14	3 app	Direct spray to lower part of plants and soil. Botran: Rate depends on timing. Apply prior to emergence in a 4- to 6-in. band, and just after thinning. Endura: Apply just after emergence or transplanting and repeat if needed. Iprodione: Apply at 3-leaf stage to just after thinning and repeat at 10-day intervals, if needed. Rotate Fontelis and Cannonball to a different mode of action after 2 consecutive apps.
	7	Endura 70WG	8 - 11 oz	14	2 app	
	7	Fontelis 1.67SC	16 - 24 fl oz	3	72 fl oz	
	12	Cannonball 50WP	7 oz	0	28 oz	
	14	Botran 75WP	2 - 5.3 lb	14	5.3 lb	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
LETTUCE, FIELD (CONT'D)						
Downy mildew Yellow spots, turning necrotic.	P1	Actigard 50WG	0.75 - 1 oz	7	4 oz	Begin applications after thinning. Do not apply to stressed crop.
	11	Reason 4.13 F	5.5 - 8.2 fl oz	2	4 app	Alternate with fungicide with a different mode of action.
	11	Quadris 2.08F	12 - 15.54 fl oz	0	92 fl oz	Alternate with a fungicide with a different mode of action. See label for tank mix precautions.
	11	Tanos 50WG	8 - 10 oz	1	48 oz	Tank mix and alternate with fungicide with a different mode of action.
	27	Curzate 60DF	3.2 - 5 oz	3	30 oz	Must tank mix with a protectant fungicide such as mancozeb.
	28	Previcur Flex 6F	2 pt	2	8 pt	Tank mix and alternate with fungicide with a different mode of action.
	40	Forum 4.18F	6 fl oz	0	5 app	Tank mix and alternate with fungicide with a different mode of action. Max. of 2 consecutive applications.
	40	Revus 2.08SC	8 fl oz	1	4 app	Max. of 2 consecutive applications before rotating to a fungicide with a different mode of action. Use with an adjuvant.
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	Tank mix and alternate with fungicide with a different mode of action.
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	Max. of 2 consecutive applications before rotating to a fungicide with a different mode of action.
	M	mancozeb 80WP[4]	2 lb	10	12.8 lb	
Pythium root rot and seedling disease	4 4 4 28	Ridomil Gold 4EC Ultra Flourish 2EC MetaStar 2E AG Previcur Flex 6F	1 - 2 pt/treated acre 2 - 4 pt/treated acre 4 - 8 pt/treated acre 2 pt	NA NA NA 2	1 app 1 app 1 app 8 pt	Apply Ridomil, Ultra Flourish and MetaStar preplant incorporated or surface application at planting. Apply Previcur Flex via transplant water, drip irrigation, sprinklers or by directing nozzles to the lower portion of the plant and soil.
LETTUCE, GREENHOUSE						
Leaf spots, downy mildew	M	mancozeb 80WP[4]	1.6 - 2 lb/43,560 ft^2	10	12.8 lb	Begin applications at first appearance of disease.
	M	fixed copper	See label	0	NL	
Botrytis	12 14 17	Cannonball 50WP Botran 75WP (leaf lettuce only) Decree 50WDG	7 oz/43,560 sq ft 2.6 lb/43,560 sq ft 1.5 lb/43,560 sq ft	0 14 3	28 oz 2 app 3 lb	Spray 7 days after transplanting and when half mature. Do not make more than 2 consecutive applications of Decree or Cannonball before rotating to a different mode action.
Powdery mildew	M	sulfur	5 lb/43,560 sq. ft.	0	NL	Do not apply if temperature will exceed 90 F within the next 3 days.
Sclerotinia drop	NC 12	Contans WG Cannonball 50WP	0.75 - 1.5 oz/1000 sq ft 7 oz/43,560 sq ft	NA 0	NL 2 app	Contans is a biological. Apply to soil about 3 months prior to planting. Till 2 in. to 8 in. deep. Cannonball is a foliar spray; must be rotated to a different mode action after 2 applications. **Botran** as used for control of Botrytis should provide some control of Sclerotinia.
Pythium root rot	28	Previcur Flex 6F (leaf lettuce only)	see label	2	6 app	See label for information on timing of applications.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
MUSTARD (SEE COLLARD)						
MELONS - Cantaloupe, watermelon, and other melons (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Alternaria leaf spot Brown, target spots on leaves. **Anthracnose** Brown leaf spots and sunken spots on fruit. **Downy mildew** Large yellow spots that turn necrotic. **Gummy stem blight** Large brown leaf spots. Gum may ooze from stem cankers. **Cercospora leaf spot** Tiny, dark brown spots.	7	Fontelis 1.67SC	12 - 16 fl oz	1	67 fl oz	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Pristine or Quadris; these products should be alternated with non-Group 11 fungicides. See Cabrio and Quadris labels for restrictions on tank mix partners. Switch, Fontelis and Luna Experience must be rotated to a different mode of action after the second application. **Note:** Spraying mature watermelons with chlorothalonil products, including Quadris Opti, may result in sunburn of the upper surface of the fruit. See label for restrictions on the use of the product. Luna Experience: 10- to 14-day spray interval; use high rate for gummy stem blight and anthracnose. **Sovran not for Alternaria, anthracnose or downy mildew. Switch and Fontelis not for anthracnose, downy mildew or Cercospora. Inspire Super not for downy mildew. Luna Experience not for downy mildew or Cercospora.**
	9,3	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
	11	Cabrio 20EG	12 - 16 oz	0	4 app	
	11	Quadris 2.08F	11 - 15.4 fl oz	1	92 fl oz	
	11	Sovran 50WG	4.8 oz	0	4 app	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
	11,7	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	11,M	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	12,9	Switch 62.5 WG	11 - 14 oz	7	56 oz	
	M	mancozeb 80WP[4]	2 - 3 lb	5	25.6 lb	
	M	chlorothalonil 6L[4]	1.5 - 3 pt	0	21 pt	
	M,4	Ridomil Gold Bravo SC	2.5 - 3.25 pt	0	4 app	
	M,4	Ridomil Gold MZ	2.5 lb	5	4 app	
	3	*For gummy stem blight only*: tebuconazole 3.6F	8 fl oz	7	24 fl oz	
	7,3	*For watermelon only:* Luna Experience 3.34SC	6 - 17 fl oz	7	34 fl oz	
Downy mildew (Additional products)	11	Reason 4.13F	5.5 fl oz	14	4 app	Begin applications prior to infection, 7- to 10-day spray schedule. Shorten spray intervals when downy mildew is active. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil or mancozeb. See label. Presidio, applied through drip irrigation for soilborne disease control, will provide some control of downy mildew.
	11	Tanos 50WG	8 oz	3	4 app	
	21	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	22,M	Gavel 75DF	1.5 - 2 lb	5	8 app	
	27	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	28	Previcur Flex 6F	1.2 pt	2	6 pt	
	40	Forum 4.18F	6 fl oz	0	5 app	
	40	Revus 2.08SC	8 fl oz	0	4 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Phytophthora blight Rot of fruit covered with thin, white mold.	21	Ranman 3.33SC	2.75 fl oz	0	6 app	Forum, Presidio, Ranman, Revus and Zampro must be involved in resistance management programs. See labels. Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2- to 4-week intervals (see label). Although not labeled for Phytophthora blight, **copper fungicides** have been shown to be helpful in suppressing this disease.
	33	phosphorous acid:				
		Agri-Fos	1.25 qt/A	0	6 app	
		Fosphite	1 - 3 qt	0	NL	
		ProPhyt	1 - 3 qt	0	NL	
		Phostrol	2.5 - 5 pt	0	7 app	
	40	Forum 4.18F	6 fl oz	0	5 app	
	40	Revus 2.08SC	8 fl oz	0	4 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Seedling disease Failure of seedlings to emerge or death after emergence.		*Rhizoctonia:*				Quadris: Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Ridomil Gold: Apply preplant incorporated, as surface band or through drip irrigation. Previcur Flex: Applied via transplant water, drip irrigation, sprinklers or directed to base of plants and soil.
	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			
		Pythium:				
	4	Ridomil Gold 4SL	1 - 2 pt/treated acre	--	1 app	
	28	Previcur Flex 6F	1.2 pt	2	6 pt	

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
MELONS (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Powdery mildew White, powdery mold on surface of leaves.	3	tebuconazole 3.6F	4 - 6 fl oz	7	24 fl oz	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products when powdery mildew appears. Do not apply sulfur if temperatures exceed 90 F. Pristine and Quintec must be rotated with fungicides with different modes of action. All other fungicides must be rotated to a different mode of action after the second consecutive application. **Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.**
	3	Rally 40W	2.5 - 5 oz	0	24 oz	
	3	Procure 50WP	4 - 8 oz	0	40 oz	
	7	Fontelis 1.67SC	12 - 16 fl oz	1	67 fl oz	
	9,3	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
	11,7	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	12,9	Switch 62.5 WG	11 - 14 oz	1	56 oz	
	13	Quintec 2.08F	4 - 6 fl oz	3	4 app	
	M	chlorothalonil 6L[4]	2 - 3 pt	0	21 pt	
	M	sulfur	see label	0	NL	
	U	Torino 0.85SC	3.4 fl oz	3	6.8 fl oz	
		For watermelons only:				
	7,3	Luna Experience 3.34SC	6 - 17 fl oz	7	34 fl oz	
OKRA						
Pod blight (whisker rot) Young pods fail to develop and deteriorate.						Remove several upper leaves to improve sunlight penetration and air circulation. Poor pollination can also affect pods.
Powdery mildew, leaf spots	3	tebuconazole 3.6F	4 - 6 fl oz	3	24 fl oz	Not often a problem. See label for resistance management guidelines.
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	61 fl oz	
	M	Bravo Weather Stik 6SC	1.5 pt	3	12 pt	
Seedling disease Poor stand.	4	Apron XL LS (seed treatment)	0.32 - 0.64 fl oz/cwt			Use thiram-treated seed. Plant in warm soil. Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence.
	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			
Verticillium wilt Yellowing of leaves. Brown discoloration inside stem.		SMDC	See nematode section			Rotate with non-solanaceous crops.
ONION, GREEN						
Downy mildew Pale green, oval, sunken spots on leaves. Purplish mold in spots.	11	Cabrio 20EG	12 oz	7	6 app	Apply when conditions become favorable for disease and repeat at 7- to 10-day intervals; Pristine: 14-day intervals. Quadris, Quadris Opti, Quadris Top, Cabrio, Pristine, Tanos and Reason should be rotated with non-Group 11 fungicides after each application. Forum, Fontelis, Switch, Inspire Super, Vangard, Presidio, Revus, Scala and Zampro should be rotated with fungicides from a different resistance management group after the second consecutive application. See resistance management sections of labels. Forum and Presidio must be tank mixed with non-related fungicides. See labels for plantback restrictions. Use silicone surfactant with Revus. * The 9 fl oz rate is for tank mixes; use the 18 fl oz rate when not mixed with another fungicide.
	11	Quadris 2.08F	9.2 - 15.4 fl oz	0	92 fl oz	
	11	Reason 4.13F	5.5 fl oz	7	4 app	
	11	Tanos 50WG	8 oz	3	84 oz	
	11,M	Quadris Opti 5.5SC	2.4 - 3.7 pt	14	3 app	
	M	chlorothalonil 6L[4]	1.5 - 3 pt	14	3 app	
	M,4	Ridomil Gold Bravo SC	2.5 pt	14	2 app	
	40	Forum 4.18F	6 fl oz	0	5 app	
	40	Revus 2.08SC	8 fl oz	7	3 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Leaf blight (Botrytis) White spots on leaves followed by dieback.	7	Endura 70WG	6.8 oz	7	6 app	
	7	Fontelis 1.67SC	16 - 24 fl oz	3	72 fl oz	
	9	Vangard 75WG	10 oz	7	28 oz	
	9	Scala 5SC	9 - 18 fl oz	7	54 fl oz	
	9,3	Inspire Super 2.82SC	16 - 20 fl oz	14	60 fl oz	
	11,7	Pristine 38WG	14.5 - 18.5 oz	7	6 app	
	12,9	Switch 62.5WG	11 - 14 oz	7	54 fl oz	
	M	chlorothalonil 6L[4]	1.5 - 3 pt	14	3 app	
	M,4	Ridomil Gold Bravo SC	2.5 pt	14	2 app	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
ONION, GREEN (CONT'D)						
Purple blotch (Alternaria) Purple target spots on leaves.		Same as for Botrytis, or	Same as for Botrytis			
	3	Cabrio 20EG	12 oz	7	6 app	
	3	tebuconazole 3.6F	4 - 6 fl oz	7	24 fl oz	
	11	Quadris 2.08F	6.2 - 12.3 fl oz	0	92 fl oz	
	11,3	Quadris Top	14 fl oz	7	42 fl oz	
	11	Reason 4.13F	5.5 fl oz	7	4 app	
	11	Tanos 50WG	8 oz	3	84 oz	
	11,3	Quadris Top	14 fl oz	7	42 fl oz	
	11,3	Quilt 1.66SC	14 - 27.5 fl oz	14	55 fl oz	
	11,M	Quadris Opti 5.55SC	2.4 - 3.7 pt	14	3 app	
ONION, DRY						
Downy mildew Pale green, oval, sunken spots on leaves. Purplish mold in spots.	11	Cabrio 20EG	12 oz	7	6 app	Apply when conditions become favorable for disease and repeat at 7- to 10-day intervals. Rovral applied at 14-day intervals. Do not apply mancozeb to exposed bulbs. Do not tank mix Aliette with copper materials. See labels for plantback restrictions. See resistance management sections of labels. Forum, Presidio and Tanos must be tank-mixed with non-related fungicides. Use silicone surfactant with Revus.
	11	Quadris 2.08F	9.2 - 15.4 fl oz	0	92 fl oz	
	11	Reason 4.13F	5.5 fl oz	7	4 oz	
	11	Tanos 50WG	8 oz	3	84 oz	
	11,M	Quadris Opti 5.5SC	2.4 - 3.7 pt	14	3 app	
	29	Omega 4.17SC	1 pt	7	6 app	
	33	Aliette 80WDG	2 - 3 lb	7	7 app	
	40	Revus 2.08SC	8 fl oz	7	4 app	
	40	Forum 4.18F	6 fl oz	0	5 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
	M	chlorothalonil 6L[4]	1.5 - 3 pt	14	3 app	
	M	mancozeb 80WP[4]	3 lb	7	32 lb	
	M,4	Ridomil Gold Bravo SC	2.5 pt	7	4 app	
Leaf blight (Botrytis) White spots on leaves followed by dieback.	2	iprodione 4F	1.5 pt	7	5 app	Apply when conditions become favorable for disease and repeat at 7- to 10-day intervals. Iprodione: 14-day intervals. Do not apply mancozeb to exposed bulbs. See labels for plantback restrictions. See resistance management sections of labels. Tanos must be tank-mixed with non-related fungicides. Scala: 9 fl oz rate for tank mixes; 18 fl oz rate when used alone.
	7	Endura 70WG	6.8 oz	7	6 app	
	7	Fontelis 1.67SC	16 - 24 fl oz	3	72 fl oz	
	9	Scala 5SC	9 - 18 fl oz	7	54 fl oz	
	9	Vangard 75WG	10 oz	7	28 oz	
	9,3	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
	11,7	Pristine 38WG	14.5 - 18.5 oz	7	6 app	
	11,M	Quadris Opti 5.5SC	1.6 - 3.2 pt	7	3 app	
	12,9	Switch 62.5WG	11 - 14 oz	7	56 oz	
	29	Omega 4.17SC	1 pt	7	6 app	
	M	chlorothalonil 6L[4]	1.5 - 3 pt	7	20 pt	
	M,4	Ridomil Gold Bravo SC	2.5 pt	7	4 app	
Purple blotch (Alternaria) Purple target spots on leaves.		Same as for Botrytis, or	Same as for Botrytis			
	3	tebuconazole 3.6F	4 - 6 fl oz	7	12 fl oz	
	11	Cabrio 20EG	12 oz	7	6 app	
	11	Quadris 2.08F	6 - 12 fl oz	0	92 fl oz	
	11	Reason 4.13F	5.5 fl oz	7	4 app	
	11	Tanos 50WG	8 oz	3	84 oz	
	11,3	Quadris Top	14 fl oz	7	56 fl oz	
	11,3	Quilt 1.66SC	14 - 27.5 fl oz	14	55 fl oz	
	M	mancozeb 80WP[4]	3 lb	7	32 lb	
PEA, ENGLISH						
Ascochyta blight Lesions on stems, pods, and leaves.	7	Fontelis 1.67SC	14 - 30 fl oz	0	72 fl oz	Alternate with a fungicide with a different mode of action after each application of Headline or Quadris or 2 consecutive apps of Fontelis.
	11	Headline 2.09F	6 - 9 fl oz	7	2 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
Seedling disease Pythium	4	Ridomil Gold SL	0.5 - 1 pt/treated A	NA	1 app	Preplant incorporated. See label for band rates.
	4	MetaStar 2E AG	2 - 4 pt/treated acre	NA	1 app	

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
PEA, ENGLISH (CONT'D)						
Seedling disease Rhizoctonia	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Terraclor is an in-furrow application.
	14	Terraclor 75WP	2 lb in 10 gal water			
PEA, SOUTHERN (Succulent only -- For dried pea culture, see "Bean, Dry.")						
Rusts Bronze pustules.	3,11	Quilt 1.66SC	14 fl oz	7	42 fl oz	Spray at early bloom and repeat at 7- to 14-day intervals. Alternate with a fungicide with a different mode of action after each application of Quilt, Headline or Quadris or 2 apps of Fontelis.
	7	Fontelis 1.67SC	14 - 30 fl oz	0	72 fl oz	
	7	Endura 70WG	8 - 11 oz	7	2 app	
	11	Headline 2.09F	6 - 9 fl oz	7	2 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
Powdery mildew Dull white, felt-like growth on leaves.	7	Fontelis 1.67SC	14 - 30 fl oz	0	72 fl oz	Begin applications at first appearance of mildew and repeat at 7- to 14-day intervals. Alternate with a different mode of action after each application of Headline or 2 consec. apps of Fontelis.
	7	Endura 70WG	8 - 11 oz	7	2 app	
	11	Headline 2.09F	6 - 9 fl oz	7	2 app	
	M	sulfur	See label	0	NL	
Mosaic viruses Distortion of leaves and pods. Pale lines in leaves.						Use virus-free seed. Plant resistant varieties.
Seedling disease Pythium	4	Ridomil Gold SL	0.5 - 1 pt/treated A	NA	1 app	Preplant incorporated. See label for band rates.
	4	MetaStar 2E AG	2 - 4 pt/treated A	NA	1 app	
Seedling disease Rhizoctonia	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			Quadris can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence.
White mold (Sclerotinia) White mold growth on pods and stems.	7	Fontelis 1.67SC	16 - 30 fl oz	0	72 fl oz	Apply at first appearance and 7 - 10 days later, if needed. Rotate to different mode of action. See label for frequency of rotation required.
	7	Endura 70WG	8 - 11 oz	7	2 app	
	12,9	Switch 62.5WG	11 - 14 oz	7	56 app	
	29	Omega 4.17SC	0.5 - 0.85 pt	14	1.75 pt	
PEPPER						
Bacterial spot Black, brown, or tan, angular spots on leaves. Dark, raised spots on fruits. Plants shed infected leaves.	M	fixed copper plus	See label	0	Label	For best results, apply before disease appears. Repeat at 5- to 10-day intervals. **High levels of resistance to copper are widespread in Tennessee populations of bacterial spot.** Alternatives to copper are encouraged. Adding Tanos to copper and mancozeb may slightly enhance efficacy. Resistant varieties are recommended. Use disease-free seed and transplants.
	M	mancozeb 80WP[4]	1.6 - 3.2 lb	7	19.2 lb	
	M	Mankocide 61.1DF	2 - 3 lb	7	39 lb	
	NC	AgriPhage	1 pt	0	NL	May be useful where copper-resistant bacterial strains are present. Cannot be tank-mixed with copper. Use as part of cooperative program with Omni-Lytics, (866-285-2644), which formulates the bacteriophage to match your bacterial strains. Resample frequently, to accommodate strain shifts.
	P1	Actigard 50WG CHILI PEPPERS ONLY	0.33 - 0.75 oz	14	6 app	Chili peppers only. Do not apply to stressed plants. Begin sprays before disease onset. See label precautions.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
PEPPER (CONT'D)						
Blossom-end rot Tan sunken areas on blossom end and side of fruit.		calcium chloride	4 lb/100 gal			Spray at first appearance. Provide proper soil pH. Avoid planting on droughty soils. Irrigate and provide uniform soil moisture.
Cercospora leaf spot Circular spots with gray centers develop on leaves. **Anthracnose** Sunken spots on ripening fruit.	11	Cabrio 20EG	8 - 12 oz	0	96 oz	Apply as soon as disease appears and continue as needed on a 7- to 10-day schedule. See Quadris, Quadris Top and Cabrio labels for resistance management guidelines.
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	61 fl oz	
	11,3	Quadris Top	12 - 14 fl oz	0	55 fl oz	
	M	mancozeb 80WP[4]	1.6 - 3.2 lb	7	19.2 lb	
	M	Bravo Weather Stik 6SC	1.5 pt	3	12 pt	
Phytophthora blight - crown and root phase (Caused by root infections.) Rapid wilt and death of plants in wet areas of field.	4	MetaStar 2E AG	4 - 8 pt/treated acre	7	12 pt	Plant on raised beds, improve field drainage and do not plant wet areas. MetaStar, Ridomil Gold and Ultra Flourish are soil-applied at planting and up to 2 supplemental soil applications at 30-day intervals. Ranman is applied in transplant water or as a foliar spray. Presidio may be applied in drip irrigation, but must be mixed with a fungicide with a different mode of action. Zampro can be applied as a directed spray at transplanting or in drip irrigation.
	4	Ridomil Gold 4EC	1 pt/treated acre	7	3 app	
	4	Ultra Flourish 2EC	2 pt/treated acre	7	3 app	
	21	Ranman 3.33SC	2.75 pt	0	16.5 fl oz	
	33	phosphorous acid:				
		Fosphite..	Pre-plant root dip: 2 qt/100 gal Drip irrig.: 2-3 qt in at least 100 gal	0	NL	
		ProPhyt.	Drench to transplants: 4 pt/100 gal In-furrow drench: 5 fl oz/1,000 ft row	0	NL	
	43	Presidio 4SC.	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	4	42 fl oz	
Phytophthora blight - foliar and fruit phase Blighting of some shoots and fruit; plant usually remains alive.	11	Tanos 50WG	8 - 10 oz	3	72 oz	Foliar sprays, for protection against infection by air-borne spores. Tanos, Presidio, Ranman, Reason, Revus, Forum and Zampro must be involved in resistance management programs. See labels. Spray intervals for phosphorous acid products: Agri-Fos: 1 - 2 wks; Fosphite: 2 - 4 weeks (see label). Phostrol: 2 - 3 weeks; ProPhyt: weekly. Although not labeled for Phytophthora blight, **copper** sprays have been shown to be helpful in suppressing this disease.
	11	Reason 4.13 SC	8.2 fl oz	14	24.6 fl oz	
	21	Ranman 3.33SC	2.75 fl oz	0	16.5 fl oz	
	33	phosphorous acid:				
		Agri-Fos	1.25 - 2 qt	0	6 app	
		Fosphite	1 - 3 qt	0	NL	
		Phostrol	1 - 2 qt	0	NL	
		ProPhyt	3 qt	0	NL	
	40	Forum 4.18F	6 fl oz	0	5 app	
	40	Revus 2.08SC	8 fl oz	1	4 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	4	42 fl oz	
	M,4	Ridomil Gold Copper	2.5 lb	7	4 app	
	M	Mankocide 61.1DF	2 - 3 lb	7	39 lb	
Southern blight Plants wilt and die. White mold often seen at base of stem.	7	Priaxor 4.17SC	4 - 8 fl oz	7	3 apps	Apply in transplant water at ½ pt per plant. Not for use after planting. Priaxor for suppression only.
	14	Terraclor 75WP	3 lb/100 gal water			
POTATO						
Black leg Stem turns black. Plant wilts and dies.	25	streptomycin sulfate 21.2WP	0.5 lb/100 gal			Soak cut seed pieces for 30 min. and plant.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
POTATO (CONT'D)						
Early blight Brown target spots followed by blighting of foliage.	2	iprodione 4F	1 - 2 pt	14	4 app	Start applications when plants are 4- to 6-in. high and continue at 7- to 10-day intervals. Alternate Ridomil products with protectant fungicide on 7-day schedule. See labels for other restrictions. See Endura, Evito, Headline, Luna, Quadris, Quadris Opti, Quadris Top, Priaxor, Reason, Revus Top, Scala, Tanos and Vertisan labels for resistance management guidelines. Scala and Tanos must be tank mixed with an early-blight fungicide with a different mode of action.
	7	Endura 70WG	2.5 - 4.5 oz	30	2 app	
	7	Vertisan 1.67EC	10 - 24 fl oz	7	72 fl oz	
	9	Scala 5SC	7 fl oz	7	35 fl oz	
	9,7	Luna Tranquility 4.16SC	4 fl oz	7	12 fl oz	
	11	Reason 4.13F	5.5 - 8.2 fl oz	14	24.6 fl oz	
	11	Tanos 50WG	6 - 8 oz	14	6 app	
	11	Evito 480SC	3.5 fl oz	7	6 app	
	11	Headline 2L	6 - 9 fl oz	3	2 app	
	11	Quadris 2.08F	6.2 - 12.4 fl oz	14	123 fl oz	
	11,3	Quadris Top	8 - 14 fl oz	14	55 fl oz	
	11,7	Priaxor 4.17SC	4 - 8 fl oz	7	3 app	
	11,M	Quadris Opti 5.5SC	1.6 pt	14	6 app	
	40,3	Revus Top	5.5 - 7 fl oz	14	28 fl oz	
	M	chlorothalonil 6L[4]	1 - 1.5 pt	7	15 pt	
	M	mancozeb 80WP[4]	2 lb	14	15 lb	
	M,4	Ridomil Gold Bravo SC	2.5 pt	14	3 app	
	M,4	Ridomil Gold MZ	2.5 lb	14	3 app	
Late blight Irregular dead areas on leaves. Plants appear scalded.	11	Reason 4.13F	5.5 - 8.2 fl oz	14	24.6 fl oz	Late-blight fungicides should be tank-mixed with and/or alternated with a broad-spectrum protectant fungicide such as chlorothalonil or mancozeb. The purpose is to discourage resistance and to provide control of early blight. Begin applications when late blight is imminent, repeat at 5- to 7-day intervals. See product labels for resistance management guidelines.
	11	Tanos 50WG	8 oz	14	6 app	
	21	Ranman 3.33SC	1.4 - 2.75 fl oz	14	10 app	
	22,M	Gavel 75DF	1.5 - 2 lb	14	6 app	
	27	Curzate 60DF	3.33 oz	14	7 app	
	28	Previcur Flex 6F	1.7 - 1.2 pt	14	6 pt	
	29	Omega 500F 4.2L	5.5 fl oz	14	3.5 pt	
	40	Forum 4.18F	4 - 6 fl oz	4	5 app	
	40	Revus 2.08SC	5.5 - 8 fl oz	1	32 fl oz	
	40	Revus 2.08SC	5.5 - 8 fl oz	14	32 fl oz	
	40,3	Revus Top	5.5 - 7 fl oz	14	28 fl oz	
	45,40	Zampro 4.33SC	11 - 14 fl oz	4	42 fl oz	
Fusarium tuber rot Dry, brown rot of stored tubers.	1	Mertect 340-F	0.42 fl oz/ton of tubers			Mist unwashed tubers on a conveyor line entering storage with enough of the solution to provide complete coverage. Tubers may be treated again before shipment if necessary.
Rhizoctonia stem canker (black scurf) Dark stem rot, poor growth.		*Seed-piece treatment:*				Apply Terraclor as an in-furrow spray to the seed and cover with soil during planting operation. Quadris and Vertisan can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high. ***Terraclor and Vertisan not for silver scurf**.
	11	Dynasty 0.83SC	0.10 - 3.75 fl oz/100 lb seed			
	12	Maxim 0.5 D	0.5 lb/100 lb seed			
	12	Maxim 4FS	0.08 fl oz/100 lb seed			
	12,M	Maxim MZ	0.5 lb/100 lb seed			
	7,M	Moncoat MZ 7.5 D	1 lb/100 lb seed			
Silver scurf Light areas with silvery sheen on surface of tuber.		*Soil treatment*:				
	11	Quadris 2.08F.	0.4 - 0.8 fl oz/1000 row ft			
	7	Vertisan 1.67EC*	0.7 - 1.6 fl oz/1,000 row ft			
	14	Terraclor 75WP*.	3.33 - 6.66 lb for 34-in. row spacing			
Scab Rough, scabby spots on tubers.						Use disease-free seed. Where soil is infested with scab organism, use resistant variety and rotate crops. See UT Extension publication SP 277-G.

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
POTATO (CONT'D)						
White mold (Sclerotinia) Dying stems with black, raisin-like structures inside.	2	iprodione 4F	2 pt	14	4 app	Begin when plants are 6- to 8-in. tall or when conditions favor disease development. Omega can be repeaedt at 7- to 10-day intervals. Apply Endura 2 times at 14-day intervals.
	3	Quash 50WG	4 oz	1	16 oz	
	7	Endura 70WG	5.5 - 10 oz	30	2 app	
	29	Omega 500F 4.2L	5.5 - 8 fl oz	14	3.5 pt	
PUMPKIN AND WINTER SQUASH (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Angular leaf spot Brown, angular-shaped spots.	P1	Actigard 50 WG	0.5 - 1 oz	0	8 oz	Spray at first appearance and repeat on 7- to 10-day schedule. Discontinue in dry weather. Fruit most susceptible when small and expanding rapidly. Do not apply Actigard to stressed plants. Requires activation time.
	M	fixed copper	See label	0	NL	
Bacterial spot (Xanthomonas) Small, tan fruit spot with dark margin.						
Anthracnose Black, circular spots on fruit.	7	Fontelis 1.67SC	12 - 16 fl oz	1	67 fl oz	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Flint, Sovran, Pristine, Quadris, Quadris Top or Quadris Opti; these products should be alternated with non-Group 11 fungicides. Switch, Fontelis and Inspire Super must be rotated to a different mode of action after the second application. See Cabrio, Quadris, Quadris Opti labels for restrictions on tank mix partners. **Fontelis, Sovran and Switch not for anthracnose, downy mildew, or plectosporium blight. Inspire Super not for downy mildew.**
	9,3	Inspire Super	16 - 20 fl oz	7	80 fl oz	
	11	Cabrio 20EG	12 - 16 oz	0	4 app	
Downy mildew Tiny yellow spots on leaves.	11	Flint 50WG	1.5 - 2 oz	0	4 app	
	11	Quadris 2.08F	11 - 15.4 fl oz	1	92 fl oz	
	11	Sovran 50WG	4.8 oz	0	4 app	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
Gummy stem blight (black rot) Black, circular spots on fruit.	11,7	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	11,M	Quadris Opti 5,5SC	3.2 pt	1	4 app	
	12,9	Switch 62.5 WG	11 - 14 oz	1	56 oz	
Plectosporium (Microdochium) blight White spots on stem and fruit.	M	chlorothalonil 6L[4]	1.5 - 3 pt	0	21 pt	
	M	mancozeb 80WP[4]	2 - 3 lb	5	8 app	
	M,4	Ridomil Gold Bravo SC	2.5 - 3.25 pt	0	4 app	
Downy mildew (Additional products)	11	Reason 4.13F	5.5 fl oz	14	4 app	Begin applications prior to infection, 7- to 10-day spray schedule. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil. Presidio, applied through drip irrigation for soilborne disease control, will provide some control of downy mildew.
	11	Tanos 50WG	8 oz	3	4 app	
	21	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	22,M	Gavel 75DF	1.5 - 2 lb	5	8 app	
	27	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	28	Previcur Flex 6F	1.2 pt	2	6 pt	
	40	Forum 4.18F	6 fl oz	0	5 app	
	40	Revus 2.08SC	8 fl oz	0	4 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Phytophthora blight Rot of fruit covered with thin, white mold.	21	Ranman 3.33SC	2.75 fl oz	0	6 app	Foliar sprays. Forum, Presidio, Ranman, Revus and Zampro must be involved in a resistance management program. Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2- to 4-week intervals (see label). Although not labeled for Phytophthora blight, **copper fungicides** have been shown to be helpful in suppressing this disease.
	33	phosphorous acid:				
		Agri-Fos	1.25 qt	0	6 app	
		Fosphite	1 - 3 qt	0	NL	
		ProPhyt	1 - 3 qt	0	NL	
		Phostrol	2.5 - 5 pt	0	7 app	
	40	Forum 4.18F	6 fl oz	0	4 app	
	40	Revus 2.08SC	8 fl oz	0	5 app	
	43	Presidio 4SC	3 - 5 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Mosaic viruses Green patterns on fruit.						Reflective mulches, aphid control and weed control may be of some value.

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
PUMPKIN AND WINTER SQUASH (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Powdery mildew White, powdery mold on surface of leaves.	3	tebuconazole 3.6F	4 - 6 fl oz	7	24 fl oz	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products when powdery mildew appears. Thorough coverage is critical for chlorothalonil and sulfur. Pristine and Quintec must be alternated with fungicides with different modes of action; all other fungicides must be rotated after the second consecutive application. **Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.**
	3	Rally 40W	2.5 - 5 oz	0	24 oz	
	3	Procure 50WP	4 - 8 oz	0	40 oz	
	3,9	Inspire Super	16 - 20 fl oz	7	80 fl oz	
	7	Fontelis 1.67SC	12 - 16 fl oz	1	67 fl oz	
	9,12	Switch 62.5 WG	11 - 14 oz	1	56 oz	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
	11,7	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	13	Quintec 2.08SC	4 - 6 fl oz	7	24 fl oz	
	U	Torino 0.85SC	3.4 fl oz	3	6.8 fl oz	
	M	wettable sulfur	see label	0	NL	
	M	chlorothalonil 6L[4]	2 - 3 pt	0	21 pt	
SPINACH						
Downy mildew (blue mold) Yellow spots on upper leaf surface. Gray downy fungus on underside of leaf.	11	Cabrio 20EG	12 - 16 oz	0	4 app	Start fungicide applications at first sign of disease and continue at 7- to 10-day intervals as necessary. Where white rust has been a problem in the past, spraying should start when the first true leaves develop. Begin Actigard applications at first or second true leaf; do not use if plants are under stress. Ridomil Gold Copper must be used with preplant Ridomil Gold EC soil application. (See below.) Aliette/Linebacker can cause speckling if leaves remain wet for long periods. Adjust spray pH to 6.0 or above. Quadris can contribute to phytotoxicity under certain conditions. Use caution with regard to tank mixes and adjuvants when treating spinach with Quadris. See Quadris, Presidio, Reason, Ranman, Cabrio, Revus and Zampro labels for resistance management guidelines.
	11	Tanos 50WG	8 - 10 oz	1	48 oz	
	11	Reason 4.13SC	5.5 - 8.2 fl oz	2	24.6 fl oz	
	P1	Actigard 50WG	0.75 oz	7	3 app	
	33	Aliette/Linebacker 80WDG	3 - 5 lb	3	7 app	
	40	Revus 2.08SC	8 fl oz	1	4 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
	M	fixed copper	see label	0	NL	
	M,4	Ridomil Gold Copper	2.5 lb	21	2 app	
White rust Yellow spots on upper leaf surface. White powdery mass on underside of leaf.	11	Cabrio 20EG	8 - 12 oz	0	4 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	92 fl oz	
	11	Reason 4.13SC	2.1 - 2.75 fl oz	0	5 app	
	11	Tanos 50WG	8 - 10 oz	1	48 oz	
	P1	Actigard 50WG	0.75 oz	7	3 app	
	21	Ranman 3.33SC	2.1 - 2.75 fl oz	0	5 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	M	fixed copper	see label	0	NL	
	M,4	Ridomil Gold Copper	2.5 lb	21	2 app	
Anthracnose Water-soaked dark gray spots.	11	Cabrio 20EG	12 - 16 oz	0	4 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	4 app	
	M	fixed copper	See label	0	NL	
Cercospora leafspot Small, tan spots.						
Rhizoctonia seedling disease Failure of seedlings to emerge or death after emergence.	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			Can be used either in-furrow at planting or in a 7-inch band over the row prior to or shortly after emergence. Use the higher rates where disease pressure is high.
Pythium seedling disease Dark rot of roots and stem.	4	MetaStar 2E AG	4 - 8 pt/treated acre	21	11 pt	Ridomil and Ultra Flourish are applied preplant incorporated or surface band at planting. For downy mildew and white rust control, shank in 0.25 pt/A Ridomil, 1 pt MetaStar or 0.5 pt/A Ultra Flourish after first and second cuttings.
	4	Ridomil Gold 4SL	1 - 2 pt/treated acre	21	2.75 pt	
Downy mildew (See above)	4	Ultra Flourish 2EC	2 - 4 pt/treated acre	21	5.5 pt	
White rust (See above)						

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
SQUASH, SUMMER (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Angular leaf spot Brown, angular-shaped spots.	M	fixed copper	See label	0	NL	Spray at first appearance and continue on 7- to 10-day schedule. Discontinue in dry weather.
	P1	Actigard 50WG	0.5 - 1 oz	0	8 oz	Do not apply to stressed plants.
Blossom blight (wet rot) Blossoms and fruits rot; whisker-like fungal growth.						Select sites and plant spacings that provide good air circulation for rapid drying.
Downy mildew Tiny, yellow spots on leaves followed by blighting.	11	Cabrio 20EG	12 - 16 oz	0	4 app	Begin applications prior to disease onset. Repeat every 7 - 10 days. Do not make consecutive applications of Cabrio, Flint, Pristine, Quadris or Quadris Opti; these products should be alternated with non-Group 11 fungicides. See Cabrio, Quadris and Quadris Opti labels for restrictions on tank mix partners. See Flint label for downy mildew control.
	11	Flint 50WG	1.5 - 2 oz	0	4 app	
	11	Quadris 2.08F	11 - 15.4 fl oz	1	92 fl oz	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
	11,7	Pristine 38WG	12.5 - 18.5 oz	0	4 app	
	11,M	Quadris Opti 5.5SC	3.2 pt	1	4 app	
Plectosporium (Microdochium) blight White dashes on stem surface.	22,M	Gavel 75DF	1.5 - 2 lb	5	8 app	
	M	chlorothalonil 6L[4]	1.5 - 3 pt	0	21 pt	
	M	mancozeb 80WP[4]	2 - 3 lb	5	25.6 lb	
	M,4	Ridomil Gold Bravo SC	2.5 - 3.25 pt	0	4 app	
	M,4	Ridomil Gold MZ	2.5 lb	5	4 app	
Downy mildew (Additional products)	11	Reason 4.13F	5.5 fl oz	14	4 app	Begin applications prior to infection, 7- to 10-day spray schedule. Most of these products require alternation with downy mildew fungicides with a different mode of action or tank mix with a protectant fungicide such as chlorothalonil or mancozeb. Presidio, applied through drip irrigation for soilborne disease control, will provide some control of downy mildew.
	11	Tanos 50WG	8 oz	3	4 app	
	21	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	22,M	Gavel 75DF	1.5 - 2 lb	5	8 app	
	27	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	28	Previcur Flex 6F	1.2 pt	2	6 pt	
	40	Revus 2.08SC	8 fl oz	0	4 app	
	40	Forum 4.18F	6 fl oz	0	4 app	
	40	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	0	42 fl oz	
Phytophthora blight - crown and root phase (Caused by root infections.) Wilt and death of plants in wet areas of field.	4	MetaStar 2E AG	4 - 8 pt/treated acre	7	12 pt	Plant on raised beds, improve field drainage and do not plant wet areas. MetaStar, Ridomil Gold and Ultra Flourish are soil-applied at planting and up to 2 supplemental soil applications at 30-day intervals. Ranman is applied in transplant water or as a foliar spray. Presidio may be applied in drip irrigation, but must be mixed with a fungicide with a different mode of action. Zampro can be applied as a directed spray at transplanting or in drip irrigation.
	4	Ridomil Gold 4EC	1 pt/treated acre	7	3 app	
	4	Ultra Flourish 2EC	2 pt/treated acre	7	3 app	
	21	Ranman 3.33SC	2.75 pt	0	16.5 fl oz	
	33	phosphorous acid:				
		Fosphite.	Pre-plant root dip: 2 qt/100 gal Drip irrig.: 2-3 qt in at least 100 gal	0	NL	
		ProPhyt.	Drench to transplants: 4 pt/100 gal In-furrow drench: 5 fl oz/1,000 ft row	0	NL	
	43	Presidio 4SC.	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	4	42 fl oz	

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
SQUASH, SUMMER (CONT'D) (For assistance with fungicide selection, see Appendix 3 for a suggested spray program and relative effectiveness of fungicides)						
Phytophthora blight Rot of fruit covered with thin, white mold.	21	Ranman 3.33SC	2.75 fl oz	0	6 app	Forum, Presidio, Ranman, Revus and Zampro must be involved in a resistance management program. Phosphorus acid products: Apply preventively on 7- to 14-day schedule, beginning after plants become established. See product labels. Exception for Fosphite: Apply at 2- to 4-week intervals (see label). Although not labeled for Phytophthora blight, **copper fungicides** have been shown to be helpful in suppressing this disease.
	33	phosphorous acid:				
		Agri-Fos	1.25 qt	0	6 app	
		Fosphite	1 - 3 qt	0	NL	
		ProPhyt	1 - 3 qt	0	NL	
		Phostrol	2.5 - 5 pt	0	7 app	
	40	Forum 4.18F	6 fl oz	0	5 app	
	40	Revus 2.08SC	8 fl oz	0	4 app	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	4	42 fl oz	
Mosaic viruses Greening of fruit. Leaves mottled, vines stunted.						The precocious yellow-stemmed varieties mask the fruit-greening effects. Some resistant varieties for certain viruses.
Powdery mildew White, powdery mold on surface of leaves.	3	tebuconazole 3.6F	4 - 6 fl oz	7	24 fl oz	For varieties susceptible to powdery mildew: Apply chlorothalonil on a preventive, 7- to 10-day schedule. Add one of the other listed products when powdery mildew appears. Do not apply sulfur if temperatures exceed 90 F. Thorough coverage is critical for chlorothalonil and sulfur. All other fungicides must be rotated to a different mode of action after the second consecutive application. **Resistance to the strobilurins (Cabrio, Quadris, Sovran and Flint) is widespread in cucurbit powdery mildew in Tennessee.**
	3	Rally 40W	2.5 - 5 oz	0	24 fl oz	
	3	Procure 50WP	4 - 8 0z	0	40 0z	
	7	Fontelis 1.67SC	12 - 16 fl oz	1	67 fl oz	
	9,3	Inspire Super	16 - 20 fl oz	7	80 fl oz	
	11,3	Quadris Top	10 - 14 fl oz	1	56 fl oz	
	11,7	Pristine 38WG	12.5 - 18.5 fl oz	0	4 app	
	11,M	Quadris Opti 5.5SC	3.2 pt	1	4 app	
	12,9	Switch 62.5 WG	11 - 14 oz	1	56 oz	
	U	Torino 0.85SC	3.4 fl oz	3	6.8 fl oz	
	M	wettable sulfur	See label	0	NL	
	M	chlorothalonil 6L[4]	2 - 3 pt	0	21 pt	
Scab Sunken or raised spots on fruit.	M	chlorothalonil 6L[4]	2 - 3 pt	0	21 pt	Begin applications prior to disease onset. Repeat every 7 - 10 days. Ridomil Gold Bravo limited to 4 applications per crop. See label for other restrictions.
	M	mancozeb[4]	2 -3 lb	5	25.8 lb	
	4,M	Ridomil Gold Bravo	2 - 3 lb	0	4 app	
SWEETPOTATO						
Plant Bed						
Black rot Black spot on roots. Dry, black decay extends in flesh of root.	1	Mertect 340F	8 fl oz/7.5 gal water			Dip seed roots for 1 - 2 minutes and plant immediately. Do not use treated roots for food or feed. Four-year crop rotation.
Scurf Brownish-black "stain" on surface of potato.	14	Botran 75WP	1 lb/7.5 gal (dip) or 3 - 3.75 lb/14 gal for 1000 sq ft (spray)			Dip seed potatoes 10 - 15 seconds, drain and bed promptly; or spray over bedded potatoes before covering with soil.
	1	Mertect 340F	8 fl oz/7.5 gal water			Dip seed roots for 1 - 2 minutes and plant immediately. Do not use treated roots for food or feed.
Southern blight (Sclerotial blight) Plants die, white growth on lower stem.	14	Botran 75WP	1 lb/7.5 gal (seed dip) or 3 - 3.75 lb/14 gal for 1000 sq ft (bed spray)			Dip seed potatoes 10 - 15 seconds, drain and bed promptly; or spray over bedded potatoes before covering with soil.
Field						
Southern blight (Sclerotial blight), Rhizoctonia stem canker, Pythium root rot	11	Quadris 2.08F	0.4 - 0.8 fl oz/1000 row ft			Apply in-furrow at planting or banded shortly after planting.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms		Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
SWEETPOTATO, Field (CONT'D)							
Foliar diseases Leaf spots, powdery mildew, rust		7	Vertisan 1.67EC	10 - 24 fl oz	7	72 fl oz	See product labels for resistance management guidelines.
		11	Headline 2.09F	6 - 12 fl oz	3	2 app	
		11	Quadris 2.08F	9.2 - 15.4 fl oz	0	123 fl oz	
		11,3	Quadris Top 2.72SC	8 - 14 fl oz	14	56 fl oz	
Soil rot (pox) Circular sunken areas on fleshy roots; feeder roots blackened.							Low pH reduces soil rot, but control should be centered around crop rotation and the use of resistant varieties.
Stem rot (Fusarium wilt) Plants yellow and stunted.							Use certified seed potatoes of a resistant variety.
Post-Harvest							
Sanitation Various rots.			Calcium hypochlorite 65%	10 oz/100 gal			Spray or dip 2 - 5 minutes. Proper curing is best control. See PB1054.
Rhizopus rot Gray, fuzzy mold.		14	Botran 75WP	Dip: 1 lb/100 gal			Dip roots for 5 - 10 seconds in well agitated suspension. Do not rinse.
				Spray: 1 lb/100 gal			Spray immediately after washing. Do not rinse after treatment.
		12	Scholar SC	Dip: 16 - 32 fl oz/100 gal			Dip for 30 seconds and allow sweet-potatoes to drain. Add 8 fl oz to 100 gal after 500 bushels are treated. After each 1,000 bushels treated, drain and flush the tank and refill with fresh suspension.
				Spray: 16 fl oz/ 200,000 lb			Ensure proper coverage of sweetpotatoes.
TOMATO, PLANT BED, OUTDOOR (For transplant production in greenhouses, see "Tomato, greenhouse")							
Damping off Lower stem shrivels and seedling collapses.	*Rhizoctonia*	14	Terraclor 75WP	4 - 8 oz/100 gal water			Soil drench applied to 400 - 800 sq ft of conatiners or beds. Can be repeated once 4 - 6 weeks later. Use fungicide-treated seed. See "Seed Treatment" section of this publication.
	Pythium, Phytoph-thora	28	Previcur Flex	32 fl oz/1000 sq ft at seeding 16 fl oz/1000 sq ft after emergence	NA	2 app	Apply in a minimum of 50 gal water per 1,000 sq ft.
Botrytis (gray mold) Gray, fuzzy growth.		M	chlorothalonil 6L[4]	1.38 - 2 pt/43,560 sq ft	NA	20 pt	Spray first true leaves, repeat at weekly intervals. For outdoor beds only.
Early blight Brown spots on leaves or stem.							
Bacterial canker, spot, speck Tiny, dark brown to black spots on leaves.			sodium hypochlorite (Clorox)	1 qt in 4 qt water	NA	NL	Wash seed for 40 min in solution with continuous agitation; air dry promptly. Use 1 gal solution per 1 lb seed.
		25	streptomycin sulfate	1 lb/100 gal	NA	NL	**For transplant production only.** Apply if symptoms appear and repeat at 4- to 5-day intervals until transplanting.
		NC	AgriPhage	3 - 8 fl oz/ 9600 sq ft	NA	NL	Apply every day if symptoms present. Do not mix with copper products.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
TOMATO, FIELD (For assistance with fungicide selection, see Appendix 4 for a suggested spray program and relative effectiveness of fungicides)						
Bacterial spot and speck Small, dark spots on foliage and fruit.	P1	Actigard 50WG	0.33 - 0.75 oz	14	8 app	Actigard is a plant resistance activator. Under certain conditions, this product may lead to reductions in yield. Refer to label for disclaimer. Begin applications within 1 week of transplanting. Make up to 8 applications, at weekly intervals. After the eighth application, switch to copper sprays if bacterial diseases are present. Begin Actigard applications at 0.33 oz/A, increasing to 0.75 oz/A as plants grow.
	M + M	fixed copper mancozeb 80WP[4]	See label 1.5 lb	0 5	Label 22.4 lb	**High levels of resistance to copper are widespread in TN populations of bacterial spot.** Alternatives to copper are encouraged. Adding Tanos to copper and mancozeb may slightly enhance efficacy. Labeled pre-mixes containing copper may also be used, but provide no advantage over this mixture.
	NC	AgriPhage	1 pt	0	NL	May be useful where copper-resistant bacterial strains are present. Cannot be tank-mixed with copper. Use as part of cooperative program with Omni-Lytics, (866-285-2644), which formulates the bacteriophage to match your bacterial strains. Resample frequently, to accommodate strain shifts.
Blossom-end rot Firm, sunken area on blossom end of fruit.		calcium chloride	4 lb/100 gal	0	4 app	Apply as soon as problem is detected or earlier. Maintain adequate calcium level in soil and uniform soil moisture. Avoid excessive irrigation when plants are small.
Early blight Brown target spots followed by blighting of foliage. **Anthracnose** Circular, sunken spots on ripe fruit. **Septoria leaf spot** Small, gray circular leaf spots with dark borders.	7 7,11 11 11 11 11,3 11,M M M	Fontelis 1.67SC Priaxor 4.17SC Cabrio 20EG Quadris 2.08F Tanos 50WG Quadris Top 2.72SC Quadris Opti 5.5SC chlorothalonil 6L[4] mancozeb 80WP[4]	10 - 24 fl oz 4 - 8 fl oz 8 - 12 oz 5 - 6.2 fl oz 6 - 8 oz 8 fl oz 1.6 pt 1.38 - 2.75 pt 2 - 3 lb	0 7 0 0 3 0 0 0 5	72 fl oz 3 app 96 oz 37 fl oz 72 oz 47 fl oz 5 app 20 pt 22.4 lb	Start spraying soon after plants are set and repeat at 7- to 10-day intervals. All products other than chlorothalonil and mancozeb must be involved in resistance management programs. See Cabrio, Quadris and Priaxor labels for precautions on tank mixes.
Fusarium wilt Bright yellowing of foliage. Brown color inside stem.						Crop rotation, fumigation and resistant varieties are treatments. Maintain soil pH between 6.5 and 7.0.
Buckeye fruit rot Circular, zonate bands within large spot on fruit, worse on lower clusters.	4,M 4,M 11 11,M 22,M 43	Ridomil Gold Bravo SC Ridomil Gold Copper Quadris 2.08F Quadris Opti 5.5SC Gavel 75DF Presidio 4SC	2.5 pt 2 lb 5 - 6.2 fl oz 1.6 pt 1.5 - 2 lb 3 - 4 fl oz	14 14 0 0 5 2	3 app 3 app 37 fl oz 5 app 8 app 12 fl oz	All are foliarly applied. Certain mefenoxam and metalaxyl products can be applied in drip irrigation, but have 28-day PHI's.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
TOMATO, FIELD (CONT'D) (For assistance with fungicide selection, see Appendix 4 for a suggested spray program and relative effectiveness of fungicides)						
Gray mold (Botrytis) Gray, fuzzy mold on blighted foliage and fruits.	7	Endura 70WG	9 - 12.5 oz	0	25 oz	Endura may only be applied 2 times per season when applied at the gray mold rate. It is labeled for early blight control at 2.5 - 3.5 oz/A. Scala must be tank mixed with one of the other listed fungicides. Rotate to a different mode of action after 2 applications of Switch or Fontelis.
	7	Fontelis 1.67SC	10 - 24 fl oz	0	72 fl oz	
	9	Scala 5SC	7 fl oz	1	35 oz	
Early blight (See above for additional products)	9,12	Switch 62.5WG	11 - 14 oz	0	56 oz	
	M	chlorothalonil 6L[4]	2.75 pt	0	20 pt	
Leaf mold Yellow spots on upper surface of leaf, olive to gray mold on underside.	11	Tanos 50WG	8 oz	3	72 oz	Tanos must be tank mixed with and alternated with a non-strobilurin fungicide such as chlorothalonil or mancozeb.
	11	Quadris Top 2.72SC	8 fl oz	0	47 fl oz	
	M	chlorothalonil 6L[4]	2.75 pt	0	20 pt	
	M	mancozeb 80WP[4]	1.5 - 3 lb	5	22.4 lb	
Late blight Large, irregular spots on leaves; firm rot of fruit.	11	Cabrio 20EG	8 - 16 fl oz	0	96 oz	Begin applications before onset of disease and repeat on a 5- to 10-day schedule. Use 5- to 7-day intervals during mild, wet weather or if late blight is present. Most of these products require alternation with late blight fungicides with a different mode of action. Tank mix with a protectant fungicide such as chlorothalonil or mancozeb. Most late blight strains are resistant to Ridomil. Do not use Revus Top on small-fruited varieties (mature fruit less than 2 in.).
	11	Quadris 2.08SC	5 - 6.2 fl oz	0	37 fl oz	
	11	Reason 4.13F	5.5 - 8.2 fl oz	14	24.6 fl oz	
	11	Tanos 50WG	6 - 8 oz	3	72 oz	
	21	Ranman 3.33SC	2.1 - 2.75 fl oz	0	6 app	
	22,M	Gavel 75DF	1.5 - 2 lb	5	8 app	
	27	Curzate 60DF	3.2 - 5 oz	3	30 oz	
	28	Previcur Flex 6F	0.7 - 1.5 pt	5	7.5 pt	
	40	Forum 4.18F	6 fl oz	4	5 app	
	40	Revus 2.08SC	5.5 - 8 fl oz	1	32 fl oz	
	40,3	Revus Top	5.5 - 7 fl oz	1	28 fl oz	
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	
	45,40	Zampro 4.33SC	14 fl oz	4	42 fl oz	
	M	chlorothalonil 6L[4]	2 - 2.75 pt	0	20 pt	
Phytophthora blight (*P. capsici*) Rot of roots and crown.	4	MetaStar 2E AG	2 - 4 qt	28	6 qt	Apply as a soil spray at planting in water or liquid fertilizer. Make subsequent application as soil spray or in drip irrigation at 4 - 6 wks after planting. Make second drip application as needed up to 4 wks before harvest. Base the rate on a 7-in. band.
	4	Ridomil Gold 4SL	1 - 2 pt/treated acre	28	3 pt	
	4	Ultra Flourish 2EC	2 - 4 pt/treated acre	28	6 pt	
	33	phosphorous acid: Fosphite	Pre-plant root dip: 2 qt/100 gal Drip irrig.: 2 - 3 qt in at least 100 gal	0	NL	Apply Fosphite at 2- to 4-week intervals in drip irrigation (see label).
	43	Presidio 4SC	3 - 4 fl oz	2	12 fl oz	Apply as a soil spray or in drip irrigation. Must be mixed with a fungicide with a different mode of action.
	21	Ranman 3.33SC	2.75 fl oz	0	6 app	Apply in transplant water or to the base of the plant at transplanting. Can also be applied to the foliage, but must involve in a resistance management program (see label).
	45,40	Zampro 4.33SC	14 fl oz	4	42 fl oz	Apply at planting as a spray directed to plant base and root zone or in drip irrigation.

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
TOMATO, FIELD (CONT'D) (For assistance with fungicide selection, see Appendix 4 for a suggested spray program and relative effectiveness of fungicides)						
Pythium root and stem rot Dark, watery rot of lower stem of young plants.	4	MetaStar 2E AG	2 - 4 qt	28	6 qt	Apply as a soil spray at planting in water or liquid fertilizer. Make subsequent application as soil spray or in drip irrigation at 4 - 6 wks after planting. For drip irrigation, base rate on a 7-in. band.
	4	Ridomil Gold 4SL	1 - 2 pt/treated acre	28	3 pt	
	4	Ultra Flourish 2EC	2 - 4 pt/treated acre	28	6 pt	
	33	Aliette/Linebacker 80WG	2.5 - 5 lb	14	20 lb	Foliar sprays.
	28	Previcur Flex 6F	1.5 pt	5	7.5 pt	Apply via transplant water, drip irrigation, sprinklers or by directing nozzles to the lower portion of the plant and surrounding soil.
Sclerotinia stem rot (timber rot) Dry, brown rot on stem. Black, raisin-like structures form inside stem.		See remarks.				The Endura tomato label does not include this disease; however, applied as for early blight control, Endura should provide suppression of Sclerotinia.
Southern blight Plants wilt and die. White mold often seen on base of stem.	14	Terraclor 75WP	3 lb/100 gal water			Applied in transplant water at ½ pt per plant. Rotate with sod crops.
Verticillium wilt Subtle wilting and yellowing.						Crop rotation, fumigation and resistant varieties are treatments.
TOMATO, GREENHOUSE						
Begin spray program when conditions are favorable for disease or as soon as disease appears. Repeat at weekly intervals. Ventilate houses well, provide continuous air circulation and maintain relative humidity below 90%. Use leaf mold-resistant varieties. Protect bumblebee hives when applying these products.						
TRANSPLANT PRODUCTION - Do not use any of these products on young plants unless experience has indicated that such use is safe.						
Early blight, gray leaf spot, late blight, leaf mold	M	mancozeb 80WP[4]	1.5 - 2 lb/43,560 sq ft	NA	22.4 lb	Apply in 100 gal of water.
Botrytis - general	17	Decree 50WG	1.5 - 2 lb/43,560 sq ft	NA	6 lb	Do not make more than 2 app. of Decree or Fontelis or 1 app. of Veranda O before rotating with a different mode of action.
	19	Veranda O 11.1WDG	6.2 oz/43,560 sq ft	0	5 app	
	7	Fontelis 1.67SC	1 - 1.5 TBSP/ gal/1360 sq ft	0	2.2 fl oz/ 1360 sq ft	
	NC	Serenade	2 - 6 qt/43,560 sq ft	NA	NL	
Bacterial spot and speck	18	streptomycin sulfate 17W	1 lb/100 gal	NA	NL	**For transplant production only.** Apply if symptoms appear and repeat at 4- to 5-day intervals until transplanting.
	NC	AgriPhage	3 - 8 fl oz/ 9600 sq ft	NA	NL	Apply every day if symptoms present. Do not mix with copper products.
Pythium root rot	28	Previcur Flex 6F	Stock solution: 12.8 fl oz/100 gal	NA	2 app	Before transplanting: Apply stock solution to pre-wet cubes at 3.4 - 6.8 fl oz per cube. Refer to label for application to soil or soilless seed beds.
	21	Ranman 3.33 SC	3 fl oz/100 gal	NA	1 app	Drench the growing medium at time of planting or anytime thereafter up until 1 week before transplanting.
AFTER TRANSPLANTING IN GREENHOUSE						
Early blight, gray leaf spot, late blight, leaf mold	11	Tanos 50WG	6 - 8 oz/43,560 sq ft	3	72 oz	**Potential for phytotoxicity exists for Catamaran. Do not apply as a mixture with any other product.** Tanos must be tank mixed with and alternated with a non-Group 11 fungicide such as mancozeb.
	M	Catamaran	4.5 pt/43,560 sq ft	0	50 pt	
	M	mancozeb 80WP[4]	1.5 - 2 lb/100 gal	5	22.4 lb	

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
TOMATO, GREENHOUSE, AFTER TRANSPLANTING IN GREENHOUSE (CONT'D)						
Botrytis - stem canker	14	Botran 75WP	1 lb/100 gal	10	4 app	Botran is sprayed to stem of plant from ground level up to height of 18-24 inches.
Botrytis - general	7	Fontelis 1.67SC	1 - 1.5 TBSP/ gal/1360 sq ft	0	2.2 fl oz/ 1360 sq ft	Foliar sprays. Do not make more 2 app. of Decree or Fontelis or 1 app of Veranda before rotating to a different mode of action. Scala must be tank-mixed with a different mode of action fungicide. Ventilate for at least 2 hours after Scala application to avoid plant damage.
	9	Scala 5SC	7 fl oz/100 gal	1	35 fl oz	
	17	Decree 50WG	1.5 - 2 lb/43,560 sq ft	0	6 lb	
	19	Veranda O 11.4WDG	6.2 oz/43,560 sq ft	0	5 app	
	NC	Serenade	2 - 6 qt/43,560 sq ft	0	NL	
	M	Catamaran	4.5 pt/43,560 sq ft	0	50 pt	
Bacterial speck, bacterial spot, early blight, late blight, Septoria leaf spot	M	fixed copper	see label	0	NL	Foliar sprays.
Pythium root rot	28	Previcur Flex	Stock solution: 12.8 fl oz/100 gal	5	4 app	After transplanting: Apply stock solution through drip system at 3.4 - 6.8 fl oz per cube. Limit to 3.4 fl oz during first 2 weeks after transplanting.
	14	Terramaster 4EC	0.01% solution, e.g., 6.5 fl oz/500 gal	3	4 app	Apply through drip system, no sooner than 3 weeks after transplanting, in volume of 6 - 8 fl oz per plant. Reapply as needed, but no sooner than 3 weeks after a previous application.
Sclerotinia stem rot (timber rot)	NC	Contans WG	0.75 - 1.5 oz/1000 sq ft	NA	NL	Biological. Apply to soil about 3 months prior to planting. Till 2 in. to 8-in. deep. **Botran** or **Fontelis** as used for control of Botrytis should provide some control of timber rot.
Powdery mildew	19	Veranda O 11.4 WDG	6.2 oz/43,560 sq ft	0	5 app	Apply preventively and continue as needed on 10- to 14-day intervals. Alternate with a different mode of action.
	7	Fontelis 1.67SC	1 - 1.5 TBSP/ gal/1360 sq ft	0	2.2 fl oz/ 1360 sq ft	
	4	Rally 40WP	2.5 - 4 oz/43,560 sq ft	0	1.25 lb	Spray at first sign of mildew and repeat at 14-day intervals.
	M	sulfur 90WP	5 lb/43,560 sq ft	0	NL	Extended spray intervals may be possible. Reapply only if mildew resumes activity. Do not apply if temps will exceed 90 F within 3 days.
TURNIP GREENS						
Alternaria leaf spot Dark brown leaf spots.	3	tebuconazole 3.6F	3 - 4 fl oz	7	16 fl oz	Begin prior to disease onset and follow 7- to 10-day schedule during rainy weather. Maintain thin plant stand and avoid low-lying or poorly drained soils. Rotate to a fungicide with a different mode of action after one application of Quadris or Quadris Top, or two applications of Inspire Super. **Tebuconazole not for anthracnose.**
	3,9	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
	3,11	Quadris Top 2.72SC	12 - 14 fl oz	1	56 fl oz	
Anthracnose Small, tan spots on leaves and stems.	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	4 app	
	M	fixed copper	See label	0	Label	
Cercospora leaf spot Tan spots, yellow haloes.						
Downy mildew Yellow leaf spots with white mold on underside.	4	Ridomil Gold SL	0.125 - 0.25 pt	7	4 app	Apply Actigard at 7-day intervals, beginning 7 - 10 days after thinning. Forum and Ridomil must be tank mixed with, and Ranman must be alternated with, a downy mildew fungicide with a different mode of action.
	P1	Actigard 50WG	0.5 - 1 oz	7	4 app	
	21	Ranman 3.33SC	2.75 fl oz	0	6 app	
	40	Forum 4.18F	6 fl oz	0	5 app	
	M	fixed copper	See label	0	NL	

Foliar, soil and post-harvest applications of disease-control products

Disease and Major Symptoms	Product Choices and Mode of Action Group[1]		Rate[2]	PHI[3]	Maximum Use/Acre/ Season	Remarks
TURNIP GREENS (CONT'D)						
Powdery mildew White, powdery growth on leaves.	3	Procure 4SC	6 - 8 fl oz	1	18 fl oz	Apply when disease first appears; continue at 7- to 14-day intervals. See product label for resistance management guidelines. **Sulfur not for Alternaria.**
	3	tebuconazole 3.6F	3 - 4 fl oz	7	16 fl oz	
	7	Fontelis 1.67SC	14 - 30 fl oz	3	72 fl oz	
Alternaria leaf spot Dark brown leaf spot.	9,3	Inspire Super 2.82SC	16 - 20 fl oz	7	80 fl oz	
	9,12	Switch 62.5WG	11 - 14 oz	7	56 oz	
	11	Quadris 2.08F	9.2 - 15.4 fl oz	0	123 fl oz	
	11,3	Quadris Top 2.72SC	12 - 14 fl oz	0	56 fl oz	
	M	sulfur	See label	0	NL	
Pythium and Phytophthora Damping off and root rot.	4	Ridomil Gold SL	1 - 2 pt/treated acre	NA	1 app	Apply preplant incorporated into top 2 in., as a soil spray at planting, or in drip irrigation at planting.
	4	MetaStar 2E AG	4 - 8 pt/treated acre	NA	1 app	
	4	Ultra Flourish	2 - 4 pt/treated acre	NA	1 app	
TURNIP, RUTABAGA (Harvested for roots only)						
Alternaria leaf spot Dark brown leaf spots.	3	tebuconazole 3.6F (turnip only)	4 - 7.2 fl oz	7	28 fl oz	Rotate to non-related chemistries after 1 application of trifloxystrobin, Cabrio or Quadris or 2 consecutive applications of Fontelis or Switch. Cultural practices are important: Maintain thin plant stand and avoid poorly drained soils. Planting in rows provides better drying conditions than broadcasting. **Tebuconazole and Fontelis not for anthracnose.**
	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	
Anthracnose Small, tan spots on leaves and stems.	11	Cabrio 20EG	8 - 12 oz	0	3 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	123 fl oz	
	11	trifloxystrobin				
		Flint 50WG	2 - 3 oz	7	4 app	
Cercospora leaf spot Tan spots, yellow haloes.		Gem 4.17SC	1.9 - 2.9 fl oz	7	4 app	
Downy mildew Yellow leaf spots with white mold on underside.	21	Actigard 50WG	0.5 - 1 oz	7	4 app	Apply Actigard at 7-day intervals, beginning 7 - 10 days after thinning. Presidio must only be applied as a tank-mix with a different mode of action.
	43	Presidio 4SC	3 - 4 fl oz	7	12 fl oz	
Powdery mildew White, powdery growth on leaves.	3	tebuconazole 3.6F (turnip only)	4 - 7.2 fl oz	7	28 fl oz	Apply at early leaf stage and repeat every 10 - 14 days, if necessary. Rotate to non-related chemistries after 1 application of trifloxystrobin, Cabrio or Quadris or 2 consecutive applications of Fontelis or Switch .
	7	Fontelis 1.67SC	16 - 30 fl oz	0	61 fl oz	
	9,12	Switch 62.5WG	11 - 14 oz	7	56 oz	
	11	Cabrio 20EG	8 - 12 oz	0	3 app	
	11	Quadris 2.08F	6.2 - 15.4 fl oz	0	123 fl oz	
	11	trifloxystrobin				
		Flint 50WG	2 - 3 oz	7	4 app	
		Gem 4.17SC	1.9 - 2.9 fl oz	7	4 app	
	M	sulfur	See label	0	NL	
Pythium and Phytophthora Damping off and root rot.	4	Ridomil Gold SL	1 - 2 pt/treated acre	NA	1 app	Apply preplant incorporated into top 2 in. or at planting as a soil spray or in drip irrigation.
	4	MetaStar 2E AG	4 - 8 pt/treated acre	NA	1 app	
	4	Ultra Flourish	2 - 4 pt/treated acre	NA	1 app	
	43	Presidio 4SC	3 - 4 fl oz	7	12 fl oz	Apply at planting as a soil spray.
WATERMELON - See MELONS						

FOOTNOTES USED IN TABLE 5:

[1] See Appendix 2 for strategies for preventing the development of pathogen resistance to fungicides.

[2] Rates are amount of formulation per acre unless otherwise stated. Usually 100 gallons of water are required to give adequate coverage with boom sprayers. Less water is required with air blast or mist blower-type sprayers.

[3] PHI (preharvest interval) is the minimum number of days between last application and harvest.

[4] Where mancozeb 80WP is recommended, flowable formulations and dry flowable formulations of mancozeb can be used at the labeled rate. Where chlorothalonil 6L is recommended, other formulations can also be used. Refer to product labels for rates.

Appendix 1

Chemical Control Products for Diseases of Vegetables

This listing does not imply any recommendations, but is provided solely as a reference. List of trade names is not complete.

Common Name	Trade Names	Type	Mode of Action Group	REI* (hours)	Formulations
acibenzolar-S-methyl	Actigard	PA	P1	12	50% WDG
ametoctradin + dimethomorph	Zampro	F	45 + 40	12	4.33 L
azoxystrobin	Quadris	F	11	4	2.08 L
azoxystrobin + chlorothalonil	Quadris Opti	F	11 + M	12	0.5 L + 5 L
azoxystrobin + difenoconazole	Quadris Top	F	11 + 3	12	1.67 L + 1.05 L
azoxystrobin + propiconazole	Quilt	F	11 + 3	24	0.62 L + 1.04 L
boscalid	Endura	F	7	12	70%WDG
chloropicrin	(R)Chlor-o-pic	Fum		72	99% L
chlorothalonil	Bravo Echo Equus	F	M	48	4.2 L, 6 L, 82.5% WDG 4.2 L 6 L, 82.5% WDG
coppers, fixed	Champ Cupro 5000 Cuprofix Disperss Kocide MasterCop Nu-Cop	B,F	M	24-48	Various
copper-sulfur	Top Cop with Sulfur	F	M	24	1 + 6.25 L
cyazofamid	Ranman	F	21	12	3.33 L
cyflufenamid	Torino	F	U	4	0.85L
cymoxanil	Curzate	F	27	12	60% DF
cyprodinil	Vangard	F	9	12	75%WDG
cyprodinil + fludioxonil	Switch	F	9 + 12	12	37.5% + 25% WDG
dicloran	Botran	F	14	12	75% WP
1,3-dichloropropene	(R)Telone II	Fum		120	94% L
1,3-dichloropropene + chloropicrin	(R)Pic-Chlor 60 (R)Telone C-17 (R)Telone C-35	Fum Fum Fum		120 120 120	39% + 59.6% L 78.3% + 16.5% L 63.1% + 34.7% L
difenoconazole + cyprodinil	Inspire Super	F	3 + 9	12	0.73 L + 2.09 L
dimethomorph	Forum	F	40	24	4.18 L
dimethyl disulfide	(R)Paladin (R)Paladin EC	Fum Fum		120 120	98.8% L 93.8% EC
famoxadone + cymoxanil	Tanos	F	11	12	50%WG
fenamidone	Reason	F	11	12	4.13 L
fenhexamid	Decree	F	17	12	50% WDG
fluazinam	Omega	F	29	48	4.2L
fludioxonil	Cannonball WP Maxim Scholar	F	12	12	50% WP 0.5% D, 4 L 1.92 SC
fluopyram + tebuconazole	Luna Experience	F	7 + 3	12	3.34 L
fluopyram + pyrimethanil	Luna Tranquility	F	7 + 9	12	4.16 L

Chemical Control Products for Diseases, *Continued*

Common Name	Trade Names	Type	Mode of Action Group	REI* (hours)	Formulations
fluopyram + trifloxystrobin	Luna Sensation	F	7 + 11	12	4.2L
fluopicolide	Presidio	F	43	12	4 L
fluoxastrobin	Evito 480SC	F	11	12	4 L
flutolanil + mancozeb	Moncoat MZ	F	7 + M	24	1.5% + 6% D
fluxapyroxad + pyraclostrobin	Priaxor	F	7 + 11	12	4.17 L
fosetyl-Al	Aliette Linebacker	F	33	12	80% WDG 80% WDG
iprodione	Rovral Iprodione Meteor Nevado	F	2	24	4 L 4 L 4 L 4L
kresoxim-methyl	Sovran	F	11	12	50 WG
mancozeb	Dithane DF Rainshield Dithane F45 Dithane M45 Koverall Manzate Flowable Manzate Pro-Stik Penncozeb Penncozeb DF Penncozeb 4FL Roper DF Rainshield	F	M	24	75% DF 4 L 80% WP 75% WP 4 L 75% DF 80% WP 75% DF 4 L 75%DF
mandipropamid	Revus	F	40	4	2.08 L
mandipropamid + difenoconazole	Revus Top	F	40 + 3	12	2.08 + 2.08 L
mefenoxam	Ridomil Gold SL Ultra Flourish	F	4	48	4 L 2 L
mefenoxam + azoxystrobin	Uniform	F	4 + 11	0	1.04 + 2.68 L
mefenoxam + chlorothalonil	Flouronil Ridomil Gold Bravo	F F	4 + M 4 + M	48 48	4.5% + 72% WP 3.3% + 33.1% L
mefenoxam + copper	Ridomil Gold Copper	F	4 + M	48	5% + 60% WP
mefenoxam + mancozeb	Ridomil Gold MZ	F	4 + M	48	4% + 64% WP
mefenoxam + PCNB	Ridomil Gold PC	F	4 + 14	48	0.5% + 10% G
metconazole	Quash	F	3	12	50% WDG
methyl bromide + chloropicrin	(R)Terr-O-Gas 50 (R)Terr-O-Gas 67	Fum		72	50% + 50% L 67% + 33% L
metiram	Polyram	F	M	24	80% DF
metalaxyl	MetaStar	F	4	48	2 L
myclobutanil	Rally (formerly Nova)	F	3	24	40% WP
oxamyl	Vydate L	N		48	2 L
PCNB	Blocker Terraclor	F F	14 14	12 12	4 L, 10% G 75% WP
penthiopyrad	Fontelis Vertisan	F	7	12	1.67SC 1.67EC
phosphorous acid	Agri-Fos Fosphite ProPhyt Phostrol	F	33	4	3.35 L 3.90 L 4.2 L 4.32 L
polyoxin D zinc salt	Veranda O Ph-D	F	19	4	11.3% WDG

Chemical Control Products for Diseases, *Continued*

Common Name	Trade Names	Type	Mode of Action Group	REI* (hours)	Formulations
potassium bicarbonate	Armicarb 100	F	NC	4	85% WP
potassium methyl dithiocarbamate	K-Pam HL	Fum		48	54% L
propamocarb	Previcur Flex	F	28	12	6 L
propiconazole	Bumper Tilt Propiconazole PropiMax	F	3	24	3.6 L
propiconazole + trifloxystrobin	Stratego	F	3 + 11		2.08 L
pyraclostrobin	Cabrio Headline	F	11	12	20% WDG 2.09 L
pyraclostrobin + boscalid	Pristine	F	7 + 11	24	38%WG
pyrimethanil	Scala	F	9	12	5 L
quinoxyfen	Quintec	F	13	12	2.08 L
sodium methly dithiocarbamate (metam sodium)	Metam CLR Sectagon 42 Vapam	Fum		72	33% L
streptomycin sulfate	Ag Streptomycin Agri-mycin 17 Firewall	B	18	4	21% WP
sulfur	Liquid Sulfur Six Microthiol Disperss Wettable Sulfur Thiolux Jet	F	M	24	6 L 80% DF 92% WP 80% DF
tebuconazole	Amtide Tebu Monsoon Orius Savannah Tebuconazole Tebusha Tebuzol	F	3	12	3.6 L
thiabendazole	Mertect 340-F	F	1	12	3.8 L
thiophanate-methyl	Topsin-M Thiophanate Methyl T-Methyl 3336	F	1	12	70% WP, 70% WDG, 4.5 L 85% WDG 70% WP, 4.5 L 50% WP
trifloxystrobin	Flint Gem	F	11	12	50% WDG 4.17 L
triflumizole	Procure	F	3	12	50% WP, 4L
triphenyltin hydroxide	Super Tin	F	30	48	80% WP
ziram	Ziram 76	F	M	48	76% DF
zoxium + mancozeb	Gavel	F	22 + M	48	8.3% + 66.7% DF

* REI (restricted entry interval) is the time immediately after a pesticide application when entry into the treated area is limited. Refer to the product label for early-entry requirements.

Guide to abbreviations used: (R) = restricted-use pesticide; B = bactericide; F = fungicide; Fum = fumigant; PA = plant activator; G = granules; DF = dry flowable; D = dust; WDG = water dispersible granules; WP = wettable powder; L = liquid. Liquid formulations are expressed as pounds of active ingredient per gallon unless percent is specified.

Appendix 2

Resistance Management

Most modern fungicides and bactericides are subject to losing effectiveness due to resistance development and must be involved in a resistance management program. The essence of such programs is to minimize the use of the product, which includes rotating it with non-related products that are effective against the target disease. A “non-related” product is one that belongs to a different resistance management group. These groups are defined and separated by their mode of action, i.e., how they attack the fungus. The Fungicide Resistance Action Committee (FRAC) has established the following table to classify disease-control products. Groups that are at medium to high risk of resistance development must be alternated or tank-mixed with members of other groups.

Table 1. Resistance management groups for disease control products for vegetables.

Group Number	Group Name and Examples
Medium- to High-Risk Groups (resistance management needed)	
1	benzimidazoles (ex. Mertect, Topsin M)
2	dicarboximides (ex. Iprodione, Rovral)
3	demethylation inhibitors (DMI’s), includes the *imidazoles* (ex. Procure) and the *triazoles* (ex. Rally, Tilt)
4	phenylamides (ex. Ridomil Gold, Ultra Flourish)
7	carboxamides (ex. Endura, Fontelis, Luna, Priaxor)
9	anilinopyrimidines (ex. Vangard, Scala)
11	quinone outside inhibitors (Qoi’s) (ex. Quadris, Headline, Cabrio, Flint)
12	phenylpyrroles (ex. Maxim)
13	quinolines, (ex. Quintec)
14	aromatic hydrocarbons (ex. Botran; Terraclor)
17	hydroxyanilids (ex. Decree)
21	quinone inside Inhibitors (Qii’s) (ex. Ranman)
22	benzamides (ex. Gavel)
25	glucopyranosyl antibiotic (ex. Agri-mycin 17, Ag Streptomycin, Firewall)
27	cyanoacetamideoximes (ex. Curzate)
28	carbamates (ex. Previcur Flex)
40	carboxylic acid amides (ex. Forum, Revus)
43	acylpicolides (ex. Presidio)
45	quinone x inhibitors (ex. Zampro)
U6	phenyl acetamides (ex. Torino)
Low-Risk Groups (resistance management not needed)	
29	2,6-dinitroanilines (ex. Omega)
30	organo-tin compounds (ex. Super Tin)
33	ethyl phosphonates (ex. Aliette), and phosphorous acid (ex. ProPhyt, Phostrol, AgriFos)
M1	inorganics - copper - Resistance management recommended for bacterial diseases (medium risk)
M2	inorganics - sulfur
M3	dithiocarbamates (ex. mancozeb, metiram, thiram, ziram)
M4	phthalimides (ex. captan)
M5	chloronitriles (ex. chlorothalonil)
P1	benzo-thiadiazole (ex. Actigard)
NC	oils, bicarbonates, biologicals (ex. neem oil, Armicarb, Contans, Serenade, AgriPhage)

M = multi-site activity, P = plant defense induction, NC = not classified

Appendix 3

Cucurbit Spray Program

Table 1. Suggested spray program for disease control in cucurbit crops.

Early season:
Use a primary fungicide (chlorothalonil or mancozeb) every 7 to 14 days (more frequently in wet weather, less frequently in dry weather). Begin the program at vine tip-over to early bloom (3 to 4 weeks after seeding). Inspect the field for disease symptoms beginning at seedling emergence so that the spray program can be started sooner than planned, if needed. If plectosporium blight appears in pumpkin or squash, Flint or Cabrio should be alternated with the primary fungicide. Otherwise, there is little need to rotate the primary fungicides with other fungicides in the early season. (Chlorothalonil and mancozeb are not subject to the development of resistance, so continued use is not a problem.)

Mid-Late Season:
Scout for powdery mildew when this disease becomes a threat, around midsummer. When the first powdery mildew colonies (circular, white patches) are seen, add sulfur, Rally, Procure, Fontelis or Quintec (if labeled) to the tank with the primary fungicide (preferably chlorothalonil, when powdery mildew is present). This tank mix can be alternated with Pristine, if desired. Do **not** depend on Flint, Cabrio or Quadris for powdery mildew control, since resistance to the strobilurins is widespread in this fungus. Various diseases can occur in mid-late season, and the choice of fungicides should be determined by which diseases appear in the current year, or have occurred in the field in previous years. Air blast sprayers are needed when canopies become thick. Apply sprays every 7 to 14 days, depending on rainfall. Add copper to the tank mix if angular leaf spot or bacterial leaf spot appear.

Table 2, on the following page, provides efficacy ratings for disease-control products labeled for cucurbit crops. It will assist in selecting the most appropriate fungicide for the diseases encountered in a field.

Table 2. Relative effectiveness of disease-control products in cucurbit crops (0 to 5 scale).

Product[a]	Alternaria Leaf Spot	Anthracnose	Downy Mildew	Gummy Stem Blight	Phytophthora Blight	Plectosporium (Microdochium) Blight	Powdery Mildew
Aliette, Linebacker	0	0	1	0	0	0	0
Cabrio	4	4	2	4	1	4	0[c]
chlorothalonil	3	4	3	4	0	3	3
copper, fixed	0	1	3	1	1	2	2
Curzate	0	0	3	0	2	0	0
Flint	4	4	1	4	0	4	0[c]
Fontelis	5	--	0	5	0	--	4
Forum	0	0	1	0	1	0	0
Gavel	3	2	4	2	1	2	1
Luna Experience	5	--	0	5	0	--	5
mancozeb	3	3	3	3	1	3	1
mefenoxam	0	0	V[b]	0	V[b]	0	0
phosphorous acid	0	0	1	0	2	0	0
Previcur Flex	0	0	3	0	1	0	0
Presidio	0	0	4	0	2	0	0
Pristine	4	4	2	5	1	3	3
Procure	0	0	0	0	0	0	4
Quadris	4	4	2	4	0	2	0[c]
Quintec	0	0	0	0	0	0	5
Rally	0	0	0	0	0	0	3
Ranman	0	0	4	0	2	0	0
Reason	2	0	3	0	--	0	0
Revus	0	0	2	0	3	0	0
sulfur	0	0	0	0	0	0	4
Sovran	--	--	--	4	--	--	0[c]
Switch	0	0	0	5	0	0	2
Tanos	–	–	4	0	–	0	0
Torino	0	0	0	0	0	0	5
tebuconazole	0	0	0	2	0	0	2
thiophanate methyl	0	2	0	2	0	2	0[c]
Zampro	0	0	4	0	0	0	0

0= not effective, 1= slight control, 2= fair control (adequate only when conditions are unfavorable for the disease), 3= moderate control (adequate in most seasons), 4= very good control, 5= excellent control. All of these ratings apply to the use of these materials on a regular, preventive schedule begun before the onset of disease.

[a] Please refer to Appendix 1 for trade names.

[b] Variable. The occurrence of resistance to this material in pathogen populations results in unpredictable control.

[c] The strobilurins and thiophanate methyl are not effective against powdery mildew because complete resistance to them is widespread.

Appendix 4

Tomato Spray Program

A tomato spray program should focus on materials that protect against early blight while also providing some protection against other diseases. A broad-spectrum material should be included each application and add specialized products, listed in this publication, as needed for other unexpected diseases that may occur, such as late blight, gray mold or Sclerotinia.

If problems with bacterial spot or speck are expected, apply mancozeb+Actigard the first week after transplanting. Use mancozeb+copper the following spray and alternate that with a strobilurin (Cabrio or Quadris)+Actigard until the allowed number of applications has been reached (6 for strobilurins, 8 for Actigard). If bacterial disease control is still needed at that time, use copper in each application. The 5-day PHI for mancozeb may not be compatible with a harvest schedule. If so, substitute chlorothalonil for mancozeb during harvest. Likewise, Actigard should be discontinued during harvest because of its 14-day PHI.

Table 1. Suggested spray program for disease control in tomato crops.

Week	Products
1	man. + Act.
2	man. + cop./phage
3	strob. + Act.
4	man. + cop./phage
5	strob. + Act.
6	man. + cop./phage
7	strob. + Act.
8	man. + cop./phage
9	strob. + Act.
10	man. + cop./phage

Week	Products
11 - begin harvest	strob. + cop./phage
12	chlor. + cop./phage
13	strob. + cop./phage
14	chlor. + cop./phage
15	chlor. + cop./phage

man. = mancozeb

Act. = Actigard

cop./phage = choice of copper or Agri-Phage

strob. = Quadris or Cabrio (strobilurins)

chlor. = chlorothalonil

In areas in which bacterial spot or speck problems are not expected, omit Actigard, copper and Agri-Phage. Copper and Agri-Phage can be added if bacterial diseases appear.

Table 2, on the following page, provides efficacy ratings for disease-control products labeled for tomato. It will assist in selecting the most appropriate fungicide for the diseases encountered in a field.

Table 2. Relative effectiveness of disease-control products in tomato (0 to 5 scale).

Product[a]	Early Blight	Late Blight	Septoria Leafspot	Gray Mold	Bacterial Spot, Speck
Actigard	0	0	0	0	3
AgriPhage	0	0	0	0	2
Cabrio	5	3	4	0	0
chlorothalonil	3	4	4	2	0
copper, fixed	2	2	2	0	3
Curzate	0	4	0	0	0
Endura	4	0	--	3	0
Flint	3	2	--	0	0
Forum	0	3	0	0	0
Fontelis	5	0	4	3	0
Gavel	3	3	3	0	0
mancozeb	3	2	4	0	0
mefenoxam	0	–[b]	0	0	0
Previcur Flex	0	3	0	0	0
Presidio	0	4	0	0	0
Priaxor	4	0	--	3	0
Quadris	5	3	4	0	0
Ranman	2	3	0	0	0
Reason	3	3	1	0	0
Revus	0	4	0	0	0
Revus Top	2	4	--	0	0
Scala	2	0	0	3	0
Switch	2	--	--	4	0
Tanos	3	4	3	0	1
Veranda O	2	1	--	2	--
Zampro	0	4	0	0	0

0= not effective, 1= slight control, 2= fair control (adequate only when conditions are unfavorable for the disease), 3= moderate control (adequate in most seasons), 4= very good control, 5= excellent control. All of these ratings apply to the use of these materials on a regular, preventive schedule begun before the onset of disease. These ratings apply to commonly used rates of the products, applied so that the plants are adequately covered.

[a] Please refer to Appendix 1 for trade names.

[b] Not recommended for late blight control because of the prevalence of resistant strains.

THE UNIVERSITY of TENNESSEE
INSTITUTE of AGRICULTURE

ag.tennessee.edu

13-0169 W 141 (Rev.) 03/13